GENERAL LIBRARY
SEP 21 1918
UNIV. OF MICH.

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

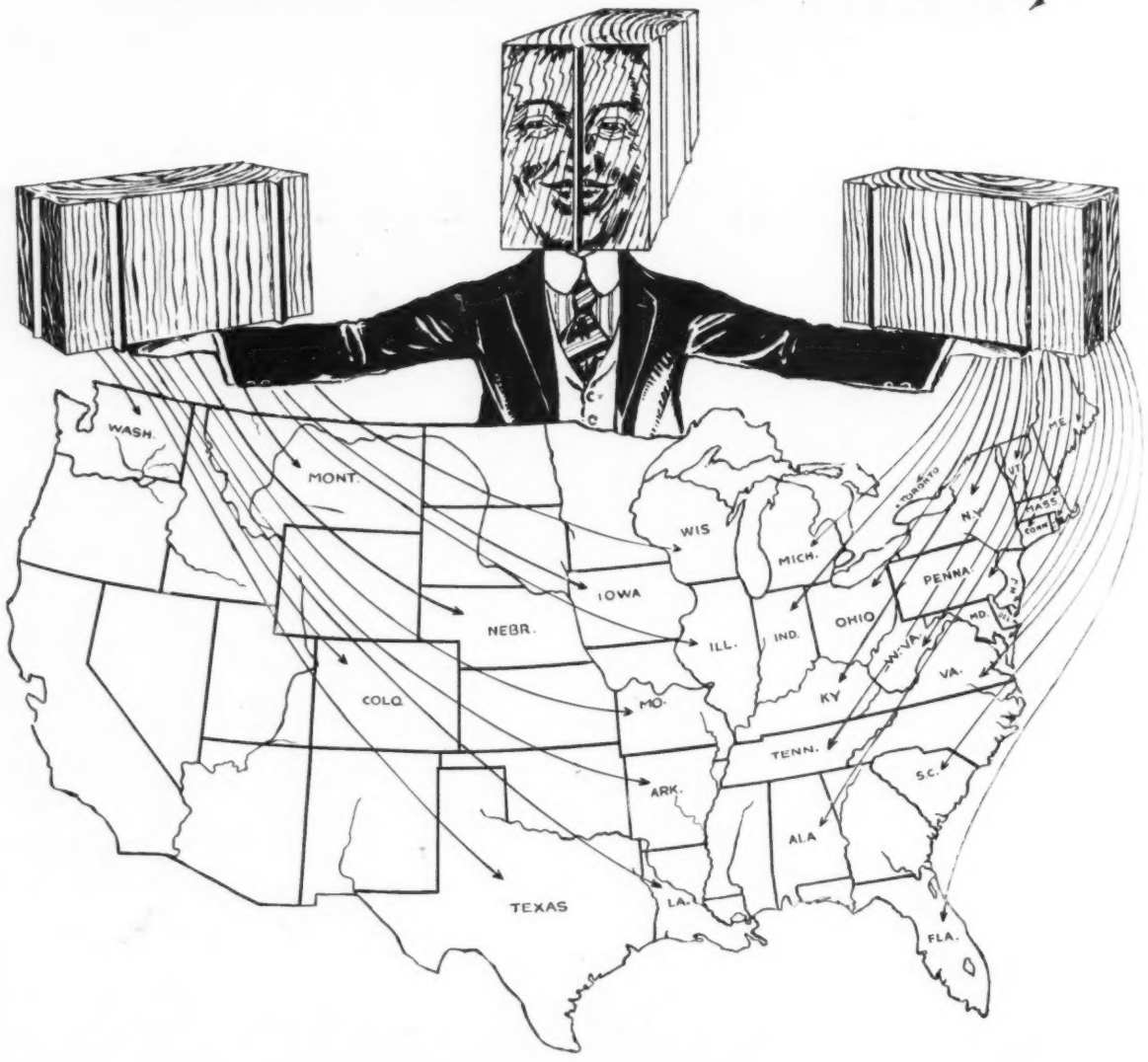
September 19, 1918

Twin Traveling Concrete Towers on Pier Shed at Boston Army Base

Kreolite Lug Wood Blocks

"The Paving that's Saving"

The "Block that's Better" is on the Map



100% Efficient

Under all kinds of traffic and climatic conditions, the Lug is the factor of safety. It absorbs the stresses of expansion and prevents buckling; permits filler to penetrate the full depth of the block on all sides; prevents the Kreolite Oil from being squeezed out of the block. Get these advantages in YOUR pavement.

"The Lug Makes a Good Block Better."

THE JENNISON-WRIGHT COMPANY

2479 BROADWAY, TOLEDO, OHIO

Volume 81 September 19, 1918 Number 12

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

Boston Army Supply Base Will Be Valuable Permanent Port Terminal 522

BUILT AT RECORD SPEED for storage of military supplies, but will remain as radical improvement of port facilities after the war—Sixty acres of storage space provided in three waterside buildings.

Engineering News-Record, Sept. 19, 1918. 9¼ cols. Ill.

Proper Radius at Intersection of Highways Discussed 526

BY G. S. EATON.

PERMISSIBLE BANKING has small effect on allowable speed—Number of automobiles necessary to warrant extra area.

Engineering News-Record, Sept. 19, 1918. 3¼ cols. Ill.

War Problems of Water-Works Practically Discussed 528

ABSTRACTS OF PAPERS AND REPORT Presented at the Win-the-War Meeting of the New England Water-Works Association.

Engineering News-Record, Sept. 19, 1918. 6 cols.

Peak Run-off Data on Restricted Dry-Wash Channels 531

SOUNDING ROD thrown forcibly from bridge into swift current to measure 18-foot velocities at 10-ft. depths.

Engineerings News-Record, Sept. 19, 1918. 3¼ cols. Ill.

Submerging Bed With Sewage Kills Sprinkling Filter Fly 533

BY DR. THOMAS J. HEADLEE AND CHARLES S. BECKWITH.

LARVAE AND PUPAE DESTROYED by 24-hours' flooding at Plainfield, N. J., without materially injuring filter bed.

Engineering News-Record, Sept. 19, 1918. 2 cols.

Engineering Supervision Improves Water-Distribution System 534

PLANS, ESTIMATES and progress records are made; flow and leakage tested; new devices and methods proposed.

Engineering News-Record, Sept. 19, 1918. 1¼ cols.

Contract Organization Vitally Important for War Work 535

BY FRANCIS DONALDSON.

LARGE-SCALE GOVERNMENT construction demands most careful coördination of forces—Charts set forth organizations for two typical contracts.

Engineering News-Record, Sept. 19, 1918. 7¼ cols.

Temporary Bridge of Old Girders Has Suspended Floor 538

DOUBLE GIRDERS carry railway tracks over highway on 85-foot span—Bolt suspension of ties gives equal loading.

Engineering News-Record, Sept. 19, 1918. 1¼ cols. Ill.

Trails Constructed by National Forest Service 539

CLASSIFICATION, forces used in construction and cost of unique class of road building in rough mountains.

Engineering News-Record, Sept. 19, 1918. 2¼ cols. Ill.

What and Where to Buy 160

Searchlight Section

Skew Subway Bridges Require Special Design 540

CHICAGO & NORTH WESTERN uses monolithic sidewalk spans with roadway having precast slabs and steel portal girders.

Engineering News-Record, Sept. 19, 1918. 4 cols. Ill.

Labor Shortage Made Good by Station Contract System 542

BY F. P. KEMON.

WINNIPEG AQUEDUCT workers speed completion of huge job at contract prices which net thirty to forty per cent. increase in wages.

Engineering News-Record, Sept. 19, 1918. 5 cols. Ill.

Turnout in High Velocity Canal Gives Good Service 545

BY J. L. LYTEL.

UNDER DROP in irrigation canal bottom diverts water to branch without affecting capacity of lateral.

Engineering News-Record, Sept. 19, 1918. 2 cols. Ill.

Railway Corporate Interests Should Be Conserved 546

BY A FORMER GENERAL MANAGER.

CREDIT MUST be sustained, and return of properties unimpaired to owners after the war is a duty under the law.

Engineering News-Record, Sept. 19, 1918. 1¼ cols.

Hints for the Contractor 553

Other Articles of Interest to Contractors:

Boston Army Supply Base Will Be Valuable Permanent Port Terminal

Contract Organization Vitally Important for War Work

Labor Shortage Made Good by Station Contract System

Editorials 519

Engineering Literature 547

Society Service 551

Letters to the Editor 551

News of the Week 556

News of Engineering Industries 561

Construction News 147

Index to Advertisers 166

67-98

McGRAW-HILL COMPANY, INC., 10th Avenue at 36th Street, NEW YORK

JAMES H. McGRAW, President
ARTHUR J. BALDWIN, Vice President
E. J. MEHREN, Vice President
EDWARD CALDWELL, Treasurer
JAMES H. McGRAW, JR., Secretary

WASHINGTON, D. C., 1410 H Street, N. W.
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
SALT LAKE CITY, 1101 Newhouse Building
SAN FRANCISCO, Rialto Building
LONDON, E. C., 6 Bouverie St.
PARIS, 3, rue Theodore-de-Banville, Paris, XVIIe
Robert K. Tomlin, Jr.
Representative and War Correspondent

Cable Address: "Machinist, N. Y."

Publishers also of
Electrical World
American Machinist
Power
Engineering and Mining Journal
Electrical Merchandising
Coal Age
Chemical and Metallurgical Engineering
Electric Railway Journal

United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines, $5 per year; Canada, $7; elsewhere, $9. Single copy, 20c.

No back volumes for more than one year and no back copies for more than three months.

Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place.

Copyright, 1918, McGraw-Hill Company, Inc. Published Weekly. Entered as second-class matter Apr 11, 1917, at the Post Office at New York, under the act of Mar. 3, 1879.

Member Audit Bureau of Circulations. Member Associated Business Papers, Inc.

CIRCULATION OF THIS ISSUE, 32,675 COPIES

LIGHT POWER BENDER IN ONE OF OUR SHOPS

To Concrete Contractors:

THE conservation and proper distribution of labor is necessary to help win the war. We can save 80% of the labor on your bending by doing the work in our shops on power machines instead of doing the work in the field, and it will cost you less money, as well as save time.

By using bar-tys, ty-chairs and other concrete specialties manufactured by us, you will also conserve labor, and at the same time save money. Let us tell you more about our time- and labor-saving devices.

CONCRETE STEEL COMPANY

42 Broadway, New York

Boston Philadelphia Birmingham Chicago Cleveland Detroit Syracuse

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, SEPTEMBER 19, 1918 — Number 12

Liberty Speaking

SYMBOLIC of the universal call and its nature is the poster heralding the Fourth Liberty Loan included with this issue. Liberty speaks to all. The response should be equally universal.

Thirteen Million Strong

EXPECTATIONS were realized in the largeness of the selective draft registration last Thursday, which reached a total of about 13,000,000. The country gladly gives men to the speedy winning of the war. It is a grim sort of rush American job on which the more force and speed used the fewer the lives we will lose and the greater the number we will help save. Altogether, then!

Spoilsmen Threaten the Next United States Census

ACCURACY, completeness, expedition, will be doubly essential in the 1920 census on account of the bearing of its data on reconstruction problems. The House has passed a bill which by letting down the bars to spoilsmen threatens the value of the next census. The Senate should be urged by engineers and engineering societies to see that the bill contains adequate civil service provisions.

Is Railroad Stock Watered?

IS RAILROAD stock watered? The first final valuation of the Interstate Commerce Commission, that of the Texas Midland R.R., scores one point for the negative side of this argument. Three cost figures for this road range from $2,850,000 to $3,700,000, as compared with a capitalization of only $2,112,000. Nor does the income account show the squeezing out of water through excessive profits; on the contrary, the annual net income has been more often negative than positive. The importance of the Texas Midland case rests solely on the fact that its was the first valuation completed. But those who cry that all railroad stock is watered cannot use this first valuation as evidence.

A Higher Plane for Society Sections

RECENT formation of a joint council representing five San Francisco sections of national engineering societies places those sections on a higher and broader plane of usefulness. Of late local sections have been growing in importance and influence, particularly in western territory where members are too far from headquarters to feel that local conditions could be thoroughly understood by the parent society, and now it is not unusual to find members of really live sections feeling that they derive more benefit from the local than the national body. Certain it is that the local organization can do effective and much needed work for the advancement of the profession. A section organized and officered so that it can grasp and successfully cope with local problems involving the betterment of conditions under which the profession works is of far greater benefit to its members than one which limits its activities to technical discussions. The sphere of the engineer is rapidly broadening, and to keep abreast of the times the technical society must likewise adopt a broader viewpoint and render service in keeping with the real needs of the engineer. The program of the San Francisco Council outlined on p. 558 indicates a realization of this fact.

War Economy Promoted by Resourcefulness

IN DIRECT response to the demand of the times, economy of the kind realized in the construction of the bridge described on p. 538 of this issue represents valuable engineering work. Our national equipment is increased whenever discarded, old material is utilized in productive service; the material and labor saved add to our stock for the time being just as surely as though an equivalent amount had been created. There is need and opportunity for many similar economies, now that war service, having enlisted the full output of mine, mill and shop, yet calls for more. To provide the increased productive capacity which is everywhere demanded, new construction is imperative. But this means that material and the use of manufacturing facilities must be secured—a more difficult task just now than finding the necessary money credit. Using old material offers a way out of the difficulty. It is dependent, however, on careful planning. The engineer's resourcefulness is of greater value here than mastery of standard forms of design.

One of War's Good Byproducts

PORT development in the United States in the early years after the war must be rapid and sure enough to provide ample accommodations for our new merchant marine. This is axiomatic; but it is hard to arouse local energy or to find local funds sufficient to start the work now. Some few ports are doing so. New Orleans is well along on its own project and Seattle has just voted bonds for an ambitious development of its already worthy accommodations, but most of the cities practice a familiar procrastination. "Sufficient unto the day" remains the municipal motto. In some of them, fortunately located for war transportation, the Federal Government is solving the problem by the construction

of army supply depots. Boston, New York, Newark and Charleston, for instance, will find themselves after the war in possession of elaborate terminal port warehouses far outdistancing any present accommodations and fitted admirably for peace-time operations. The control of such terminals—whether it be Federal, state, municipal or private—is among the many post-war problems to be solved, but the benefit of having such facilities ready to hand would be one of the few good things incidental to the war.

Unification and the Railroad Contract

JUST what the owners of the railroads are to get as a result of the taking over of their properties by the Government is still undetermined. True, what Director General McAdoo asserts is the final form of the contract has been given forth, and the Railroad Executives' Advisory Committee endorses it. The National Association of Owners of Railroad Securities does not, however, and so long as it holds to its present attitude—not to oppose the Government's operations in any way, but merely to insist on leaving open for the courts to decide who shall pay the bills and the damages—it seems to have the better of the argument.

Unification and the preservation of each railroad's integrity are incompatible. Much, according to the Director General's report to the President on the first seven months of Government operation, has been accomplished in the way of unification, but this much is only a beginning of what is possible if the roads are in truth to be treated as a single vast railroad system. Roundabout routes that have been painfully developed to give carriers a chance at traffic on which they had no rational claim are already going into the discard; and on the other hand, lines which had only secondary value to the properties of which they were part are being combined with secondary lines of other properties to form very useful routes. Merely a hasty glance at the maps in the railway guide will reveal the haphazard way in which some companies have pursued their policies of annexation, while a more careful comparison of the maps will reveal how effectively some of the misfit lines could be traded off to other companies. And this trading is being done by the Government for the period of the war. It is an essential part of unification, and the longer the war lasts the more revising of the maps in the railway guide will take place, the more diversion of traffic from uneconomic routes will be made, and the more nearly impossible it will be to return the properties to their owners as they were before the war.

Possibly the security holders themselves were the first to realize the extent to which ostensibly temporary control could change the railroad map. At first it seemed that in their zeal to protect themselves they were trying to deter the Railroad Administration from effecting the economies of unification. If they were they have abandoned that plan. They now submit to whatever mutilation of their properties is necessary for winning the war, and ask only that they be permitted when they have seen the results to lay their cases before the courts. If their properties are to come back to them they want the right to claim compensation for whatever, including traffic, does not come back. If the Government is to retain them permanently they do not want going value that has been destroyed during the period of the war to be thrown out of the reckoning without the right of appeal to the courts. Also, they do not wish to pay present-day high prices for improvements of which the Government will get the sole benefit during the war—improvements they might not need at all after the war, but could perhaps, if required, build much cheaper then. Their contentions seem reasonable.

There is another argument for granting their demands. While whatever is needed for winning the war should be done, it should not be forgotten that the owners are still the owners, though their property was taken away from them almost overnight, and every care should be taken to avoid *unnecessary* damage to that property. And unnecessary damage is more likely to be avoided if the door is not barred to the presentation of claims for damage.

Whether the courts would award damages for traffic diverted and good will destroyed—that is a very different question. It may be argued that a traffic which could not justify itself to the Railroad Administration, and was turned to other lines in the interests of economy, was worth nothing, and that the cost of developing it was money thrown away. That question, with all of the other points, the courts could decide—after the event.

It may still be argued that the owners are under no compulsion to sign the contract at all. But there is general agreement that in most respects the contract admirably covers the situation. With the whole matter in suspense the owners would not be much better off than if tied to a contract that gave them a large part of what they sought.

Water Taste Problem Serious at Milwaukee

APPRECIATION of the necessity of safeguarding a city against contaminated water by disinfection is yet far from being universal. This was brought out most clearly in Milwaukee recently in an open hearing on the subject of increased typhoid incidence and water taste. The hearing was before the local Board of Health and was attended by representative business men and officials of the Association of Commerce. The latter suggested boiling by the consumer in place of sterilizing at the pumping station, so as to get away from the taste, little realizing the almost impossible task of educating everybody to drink boiled water only. The Milwaukee situation is unusual. Gas house wastes combined with the chlorine make such a disagreeable taste in the water that complaints almost overwhelm the water-works officials. Dr. Ruhland, health commissioner, stated that recently an employee at the pumping station, to whom complaints had been made, eliminated the chlorine application for a 12-hour period, but a system of checks had been devised so that this could not happen again. Gas company officials, who attended the hearing, promised to cease discharging the wastes from their plants into the lake after Dr. Ruhland had demonstrated that a combination of gas house waste, chlorine and spring water in the same proportions as in the city water gave the same disagreeable tastes. Milwaukee appro-

priated $30,000 not long ago for experiments in water filtration. The results, conclusions and designs for a purification plant can come none too soon.

Defining Shortage Would Help

THERE is plenty of bad feeling in industrial and construction circles which would not exist if there were a more general understanding of what is meant by "shortage" of materials or transportation of labor by the federal officials who are trying to apportion these vital resources among governmental and private applicants. It is exasperating for a manufacturer who wishes to fill a contract from material in stock to be told to keep that material because essential war-time work requires it. He knows nothing of government orders in prospect and can learn nothing about them. The government merely says that the whole output must go to swell the already large stock because there is a "shortage."

The explanation of this situation, such as it is, is that only those persons who are actively engaged in allocating our country's products on the basis of the estimated war-time requirements and civilian needs can form any idea at all of the relation between future demands and probable future supplies. The men who are dealing with priorities in Washington receive from the War and Navy Departments, the Allied Purchasing Board and the Emergency Fleet Corporation notices of the materials they will need months ahead of the dates when deliveries must be made. These requirements mount up to staggering totals, as the little information the officials give out from time to time shows. Probably these imposing total requirements affect their judgment of what can be given for civilian needs, for they are primarily concerned with the things that will win the war and private needs necessarily occupy a secondary place in their thoughts. It is unfortunate that this is so, but it would take a superman to think otherwise when harassed with war essentials. And as a result of this, all through the summer, work has been checked on account of "shortage" although nobody connected with the work could see the slightest lack of anything for the orderly prosecution of the undertakings.

It is unfortunate that those who have official knowledge of these future shortages have been unwilling to speak more openly and clearly about them, because the absence of any information regarding their reasons for closing down work when money, materials and labor were apparently available for it makes their orders seem like the decisions of persons having authority but lacking judgment. Such explanations as have been given out generally indicate that the "shortage" which is most feared is that of fuel, and consequently materials which require fuel in their production should be used with the utmost economy and be replaced by those requiring less fuel, so far as possible. Even this explanation is not made officially by any board having authority to speak, but merely exudes occasionally from some harassed official, as a sort of generally accepted principle governing the attitude of those who are applying brakes to public and private works which those in charge can see no reason for checking.

A clear statement of the actual condition of the labor and material fields, as seen by the officials who are stopping work on account of shortages which cannot be seen by those not in official position, would be welcome. The generalities occasionally given out to the press by publicity departments without any knowledge of the information desired by men engaged in industries and construction are calculated merely to exasperate these men, because the assertions made concerning the shortages which are the reason for restrictive action do not agree with the facts as they see them.

Will Denver Justify Municipal Ownership of Its Water-Works?

DENVER having achieved municipal ownership of water-works after years of effort it is now incumbent upon the city government and the newly created water board to see that the city has at least as efficient a water service as was furnished by the company which it so much desired to eliminate.

Water-works efficiency includes quality, quantity, pressure, prompt extensions of mains and provision of new services where needed, courteous and fair dealings with consumers and economy of operation. We pass no judgment upon the efficiency of the Denver water-works under private ownership, nor do we question the possibility of efficiency under municipal ownership at Denver or elsewhere. There are pitfalls to be avoided under either form of ownership.

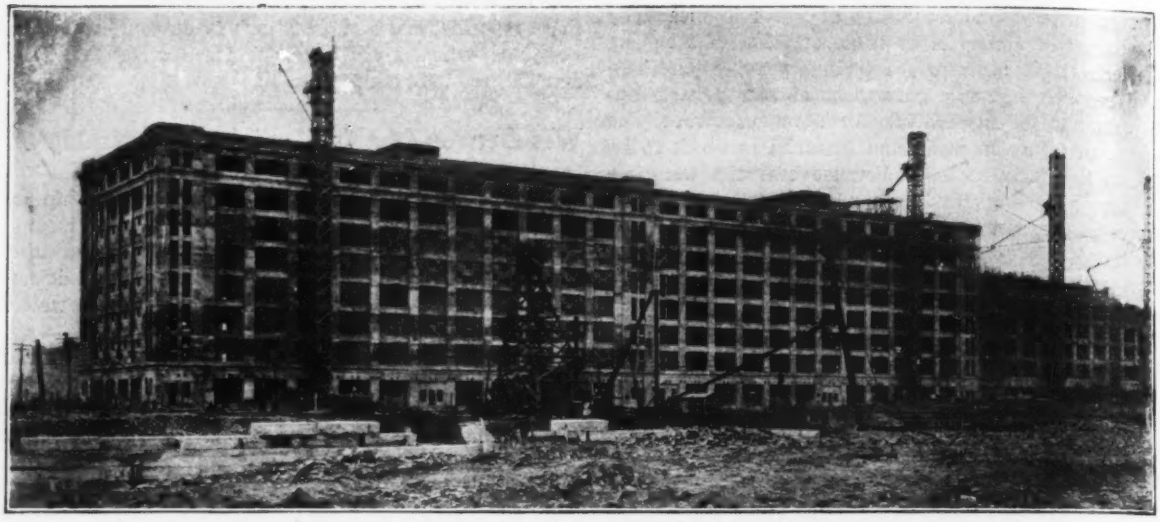
Chief among dangers at Denver and elsewhere under city ownership are that sinister political rather than sound business considerations will govern the selection of the working force, the manifold operations of the works, and particularly financial policies and methods, including rate fixing and accounting. Under city ownership it is too easy and too common to curry popular favor by lowering water rates unduly, juggling or neglecting the accounting system so as to blind the fact that a considerable part of the burden of providing a public water-supply is placed on the shoulders of the tax-payers—present or future—instead of upon the water consumers. Or, yielding to other considerations, the taxpayer may be spared by putting the burden of a water-supply for public purposes wholly upon the water consumer.

Much depends, at Denver and elsewhere, upon the chief executive and his staff chosen to operate the water-works. But it is not enough to choose able men. They must be given a reasonably free hand and have the backing of the city government, the water consumers and the citizens generally.

In war time, particularly, no municipal service is more vital than water-works. Denver has achieved its desire of years to own and operate its works. It is doubly imperative just now that it, as well as other water-works in the country, should be operated with efficiency, which includes economy and due regard to the interests of consumers and taxpayers. Under these circumstances, and as the latest example of change from private to public ownership of water-works in a city of considerable size, many eyes will be turned to Denver when it assumes ownership and operation of the water system.

Boston Army Supply Base Will Be Valuable Permanent Port Terminal

Built at Record Speed for Storage of Military Supplies, But Will Remain as Radical Improvement of Port Facilities After the War—Sixty Acres of Storage Space Provided in Waterside Buildings



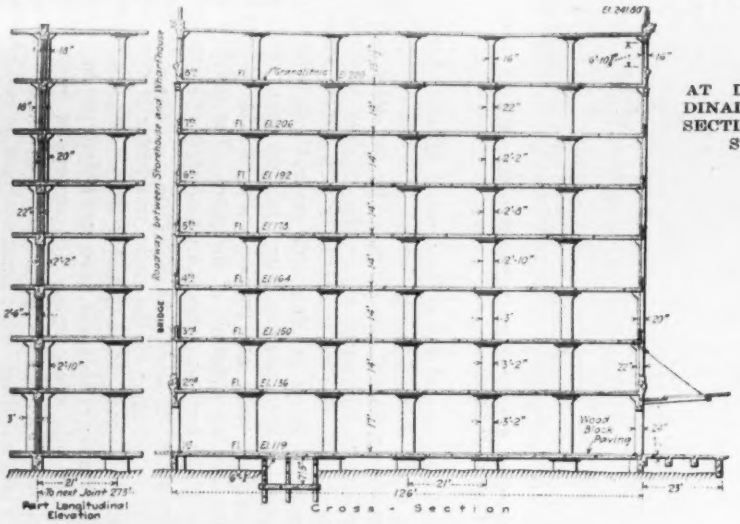
LOOKING AT THE OUTER END OF THE 1638-FOOT LONG STOREHOUSE UNDER CONSTRUCTION AT THE NEW BOSTON ARMY SUPPLY BASE

ARMY port terminals to store and handle the vast quantities of supplies required by the overseas forces are being built in several of the Atlantic and Gulf cities. Some of these are of the one-story timber-shed type, spreading over a large area and requiring entirely horizontal transportation in handling freight. In construction and layout such terminals are temporary, though in all probability they will remain in use many years in such ports as require their service. The larger army terminals, however, have multi-story concrete warehouses and transfer houses with waterside connections, and although they are being built under forced pressure for immediate war use they are of such design as will make them a most valuable part of the necessary post-war facilities in the ports where they are located. In this latter class is the new Boston army supply base.

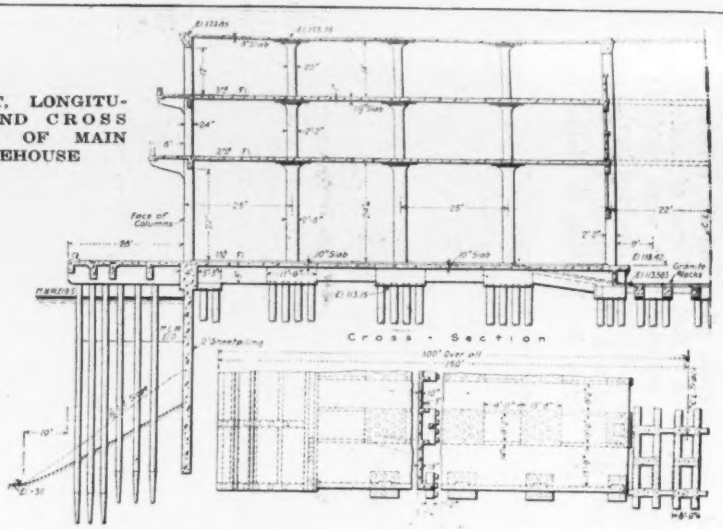
The site of the new terminal is a formerly unoccupied area in the harbor of Boston. Its long side borders on a channel now having a usable depth of about 30 ft., and its far end projects toward the 35-ft. main ship channel of the harbor, forming a pier-like area with deep-water frontage on the two sides and the end. The shore end of the lot is convenient to trunk-line railroads and has sufficient area to permit of the layout of a large railway yard leading up to the warehouse section. When the army entered upon the property the water lines were marked by wooden bulkheads which were not coincident with the new bulkhead lines required, so that considerable filling and dredging have been required to delimit the area shown on the accompanying drawing. Furthermore, the channels adjacent to the terminal were nowhere near the required 35-ft. depth, and dredging to the extent of some 2,800,000 yd. will have to be completed to make the terminal accessible at all places to deeply laden vessels.

The principal structures of the base are the main storehouse, the wharf shed and the pier shed. The main storehouse is an eight-story reinforced-concrete building 126 ft. wide and 1638 ft. long. It is divided into six equal sections, each 126 x 273 ft., but the separations between the different sections are only structural; the building is a unit containing 1,651,100 sq.ft. of floor area. Joined to this storehouse by bridges across an 86-ft. paved street containing railroad tracks is the wharf shed, which is alongside the 35-ft. channel and accessible to and from ships lying along the wharf. This wharf shed is 100 ft. wide and 1638 ft. long and has two stories. It is to be built with a wooden-pile and reinforced-concrete substructure carrying a steel frame. At the far end of the plot is the so-called pier shed, which is to be used during the war by the Navy as a storehouse. This pier shed consists of twin buildings each 100 ft. wide by 924 ft. long and three stories high, connected by bridges and built of reinforced concrete. The wharf shed has a floor area of about 360,000 sq.ft., and the Navy pier shed of about 580,000, giving a total floor area, of the main buildings of the entire terminal, of 2,600,000 square feet.

In so far as war operation is concerned, the pier shed is to be separate from the storehouse and the wharf shed, and will receive and deliver its stores without reference to the layout of the other two buildings. After the war, if the plant is turned over to commercial operation, it can be worked into the general scheme of the terminal. For war operation, the army stores to be transported overseas are brought in over the main-line tracks and stored and classified in the extensive

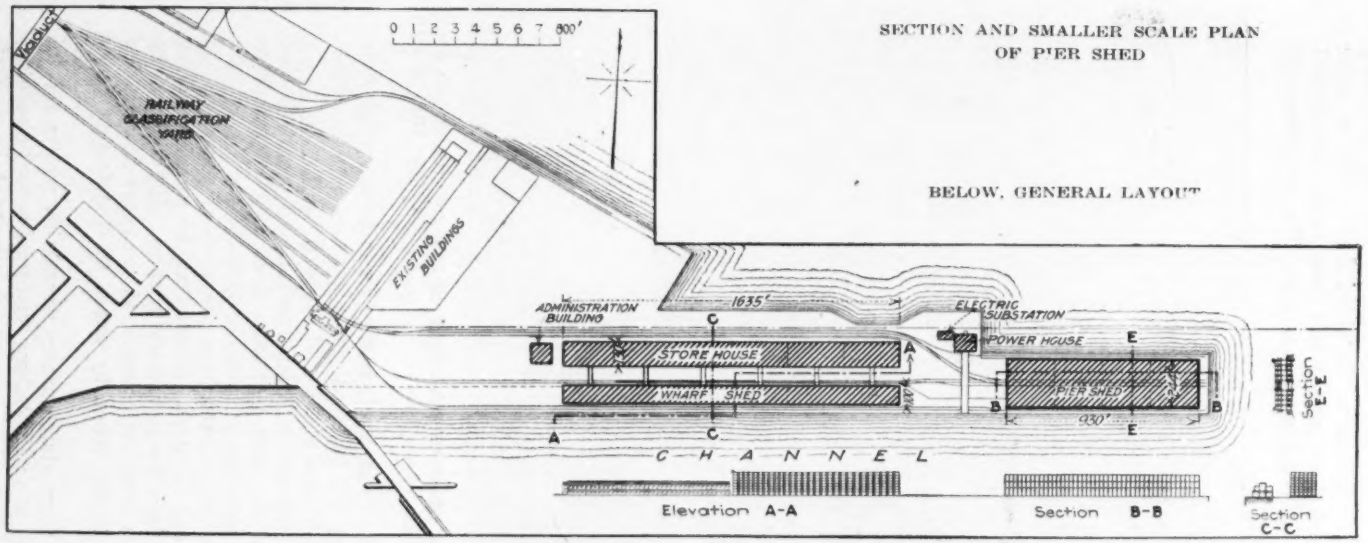


AT LEFT, LONGITUDINAL AND CROSS SECTIONS OF MAIN STOREHOUSE



SECTION AND SMALLER SCALE PLAN OF PIER SHED

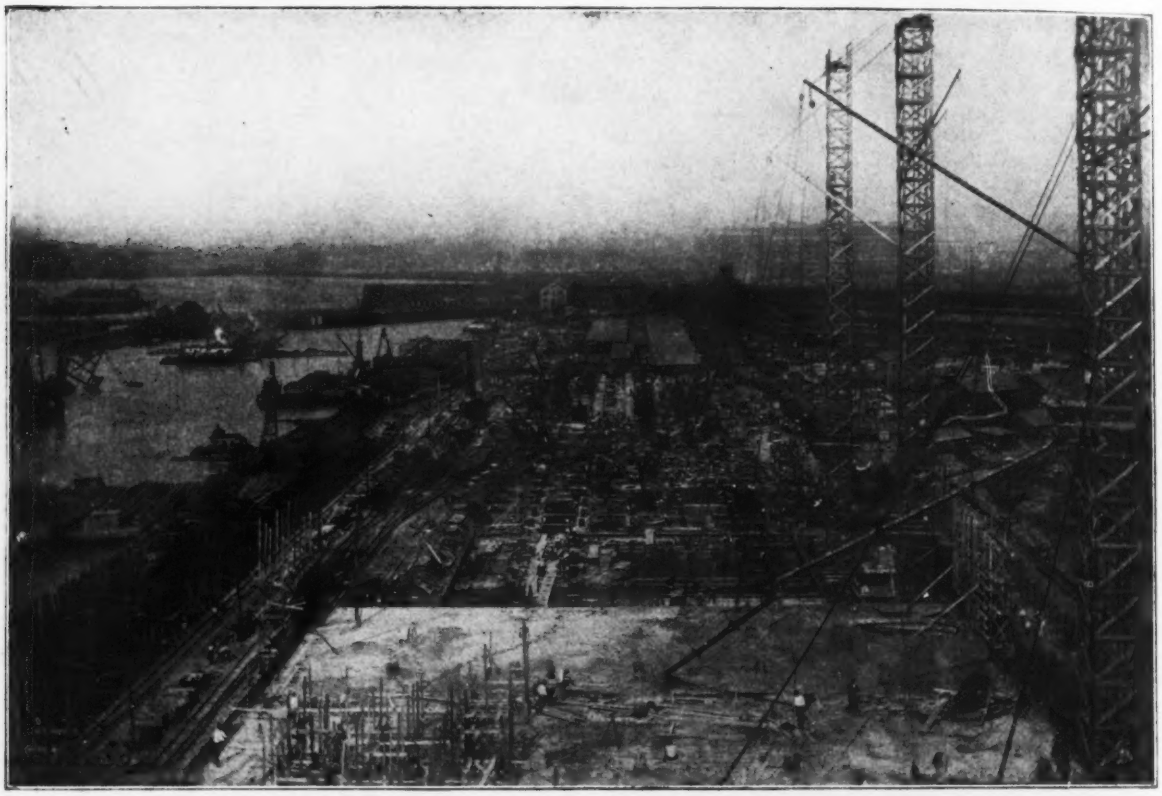
BELOW, GENERAL LAYOUT



NEW BOSTON ARMY SUPPLY BASE COMPRISES THREE BUILDINGS AND TWO WHARVES ON 35-FOOT CHANNEL IN THE HARBOR

railway approach yard. Carload lots will then be brought to the main storehouse, on the railroad tracks on the northern side, and delivered to the eight floors by trailer trucks and elevators.

The wharf shed is to be used for the assembly and short-time storage of freight which will be loaded onto vessels. This freight may be taken from the storehouse or brought directly to the wharf shed by rail or motor truck, and stored on the first floor, ready to be loaded aboard the vessel when it arrives. The storehouse will



VIEW FROM UPPER STORY OF ONE OF THE OUTER STOREHOUSES, LOOKING SHOREWARD OVER FOUNDATION WORK. WHARF SHED PILES AT LEFT

be used as a reservoir to care for materials which it is expected will be stored for some time, and to supply cargoes in case of delay of expected shipments.

The pier shed is to be provided with tracks running between the twin buildings, from which tracks cars can be unloaded to trailer trucks and the freight can be distributed throughout the shed by means of the trucks and elevators. Material will be moved by trailer trucks from the pier sheds to ships. Material will be unloaded from the balconies at the upper floors to the ships, or vice versa, by means of a system of cargo hoists.

The main storehouse is remarkable mostly for its size. It is an eight-story reinforced-concrete building, 126 x 1638 ft. The structural details are of the simplest. Flat-slab floors on the two-way system are carried on round columns spaced 21 ft. center to center in both directions, a maximum uniformity in panel sizes being adopted. The structure rests on concrete cylinder piers 6 ft. in diameter, one pier to each column, the piers rising for their full shaft diameter to the under side of the first floor, which floor is carried on the pier by the usual drop head. In preparing the original design comparisons of various types of footings were made, wood piles, concrete piles, and the cylinder piers all being analyzed as to cost and ease of construction. In every way the cylinder piers were estimated to be superior. Their construction has been carried out with remarkable speed and effectiveness.

As stated above, the building is divided into six equal sections and was so constructed, the section nearest the outer channel being started first and construction proceeding toward the shore. The end walls of each section are continuous across the building between the columns, which are separated for each section, complete expansion joints running clear across the building. The expansion joint extends below the first floor, where the respective walls are carried each on separate beams spanning the pedestals of the piers. The openings between the various sections are provided with fire doors. The outer walls are of concrete.

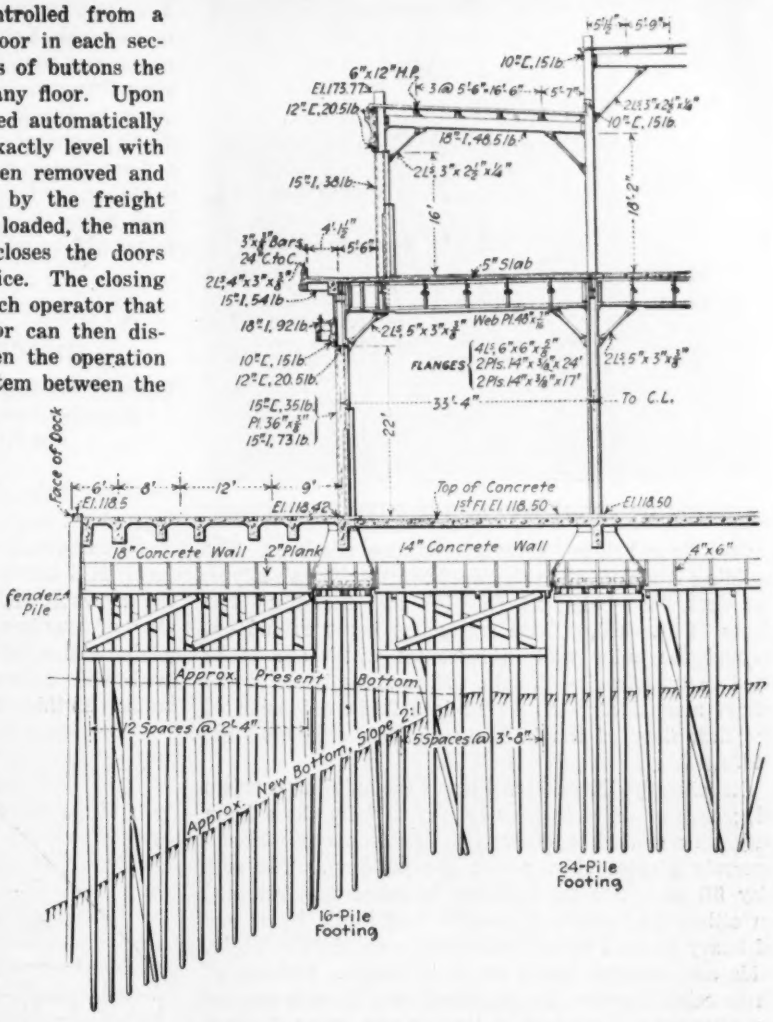
The first floor of the main warehouse is on a level with the street, so that motor trucks can run directly onto the floor; this will have wood-block paving to take care of this extra wear. The remaining floors of the building have a 1-in. granolithic surface.

Transportation inside the storehouse is to be effected by means of tractor and trailer trucks and elevators. The elevators, which carry four trucks each and have a capacity of 10,000 lb. at a speed of 150 ft. per minute,

are remarkable in that they are controlled from a central dispatch station on the third floor in each section of the building. Through a series of buttons the operator can dispatch the elevator to any floor. Upon arrival at the floor the doors are opened automatically and the car is automatically brought exactly level with the landing. The empty trucks are then removed and loaded trucks pushed on the elevator by the freight handler at the floor. When the car is loaded, the man at the floor presses a button which closes the doors by means of an automatic electrical device. The closing of the door gives a signal to the dispatch operator that the car is ready for use. The operator can then dispatch the car to the proper floor, when the operation is repeated. A complete telephone system between the dispatcher and each floor keeps the operator in constant communication with all parts of the building. This method of elevator control insures the obtaining of the maximum capacity from the elevators.

Automatic interlocking devices prevent the elevator doors being opened unless the car is at the landing, and also prevent the operation of the car unless all doors are closed. A lamp signal system on the dispatcher's desk indicates the exact position of each elevator in the well. To provide for trouble with the automatic operation each elevator has a car switch which will permit the manual operation of the car.

A rectangular tunnel having two parts runs longitudinally under the storehouse. One part contains high-pressure steam pipes for heating the building; the other part contains the electrical distributing mains. This tunnel is connected at its eastern end to the electric substation and to the boiler house. The storehouse is to be heated by a combination sprinkler and heating system, with auxiliary low-pressure steam radiators at the walls.



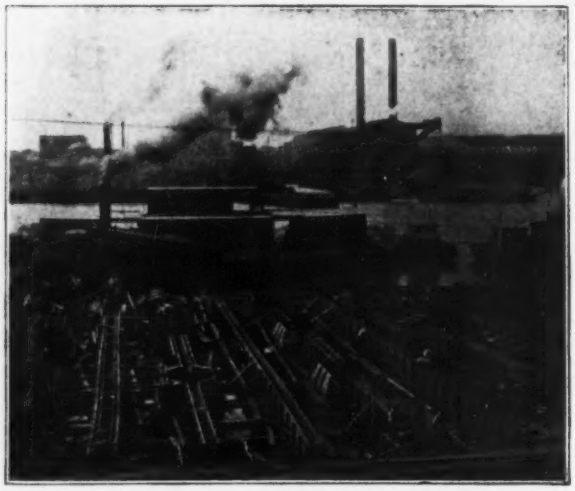
WHARF SHED HAS STEEL SUPERSTRUCTURE ON CONCRETE BASE AND TIMBER PILE FOUNDATION

The wharf shed was built mostly over the water, the old bulkhead running just outside the inner wall of the shed, as shown in some of the drawings. The shed itself is of the simple steel-frame type made familiar in the various transoceanic piers of the Atlantic ports. It is 1638 ft. long by 100 ft. wide and divided into three transverse bays each 33 ft. 4 in. wide. The second floor, of concrete carried on steel floor-beams, extends out as a balcony on the water side, to permit the unloading of package freight. The first floor is at the level of the adjoining street. The outside walls are of concrete, between the very numerous vertical lift doors.

The substructure consists of transverse concrete walls carrying the longitudinal concrete beams and the concrete floor, the walls spanning between pedestals resting on timber pile groups. Additional piles are spaced between the pedestal groups so as to form cross bents and to carry part of the load of the main deck of the wharf. The details are shown in one of the drawings. Transverse expansion joints occur through the building every 546 ft. An interesting detail is the embedment directly in the concrete of the rails for the railway tracks along the capsill of the wharf.

The elevators in the wharf shed are similar in size and capacity to the storehouse elevators, but are controlled by an operator on the car. The doors, however, are electrically operated by buttons in the car and on the landings. Freight is to be moved from the wharf shed to the ships by means of semi-portal bridge cranes and a system of cargo hoists, on the water side of the wharf shed, taking the freight from trucks or trains on the wharf or on the balcony in front of the second floor of the shed.

The pier shed is a reinforced-concrete structure 924 ft. long, divided into four sections of 231 ft. each, and 300 ft. total width. It is in reality composed of two longitudinal buildings, each 100 ft. wide, connected by four bridges, with an intermediate 44 ft. in which run three standard-gage railroad tracks. These tracks are depressed, as shown in the drawing, so as to bring the car door flush with the first-floor level and also so as to give free clearance of the trains beneath the



PUTTING UP FORMS FOR WHARF SHED STRUCTURE

second floor bridges between the two sections. The building is also of the reinforced-concrete flat-slab type, the first floor being 24 ft. high and the other two floors 14 ft. each. These upper two floors extend out beyond the outer wall in balconies which are to be used in transferring freight to the ships lying at the wharf alongside. This wharf is a 28-ft. extension of the first floor of the building on both sides and the end.

Structurally, the substructure of the building consists of groups of concrete piles capped to form the column pedestal and tied together with transverse reinforced-concrete girders clear across the building. The soft clay fill on which the building is founded is retained on either side within the outer wall limits by a row of heavy precast reinforced-concrete sheet piles 21 in. wide and running up to 48 ft. in length. Outside of these retaining piles the marginal road floor is carried on piles with short penetration in the outer dredged slope.

The elevators in the pier shed are similar to the storehouse elevators except that they are controlled by buttons at the landings instead of from a central point.

Between the pier shed and the main warehouse will be located a central boiler house to supply heat for the whole project. Connected with the boiler house will be an overload coal bunker equipped with modern coal unloading and handling machinery.

All the current for lighting and power will be obtained at high tension from the Edison Electric Illuminating Co., and will be transformed for distribution about the site in a substation near the boiler house. There will also be an administration building at the shore entrance to the site.

The Boston army supply depot is being built under the direction of the Construction Division of the Army, Brig. Gen. R. C. Marshall, Jr., in charge. The engineering design and supervision are in charge of the firm of Fay, Spofford & Thorndike, consulting engineers, Boston, and the construction is being carried out under the direction of Maj. C. R. Gow, constructing quartermaster. The main contract is held by the W. F. Kearns Co., Cambridge, Mass., but the substructure for the main storehouse was let to the P. McGovern Co., New York and Boston; the substructure of the wharf shed to Holbrook, Cabot & Rollins, Boston; the substructure of the pier shed to the Raymond Concrete Pile Co., and the railway track work, grading, and underground structures to the T. Stuart and Son Co., Newton, Mass. Work was started Apr. 3 of this year, and is scheduled for completion, with the exception of some of the outer dredging, by the first of the year. Rapid progress has been made and it is practically certain that the terminal will be ready for operation before that time.

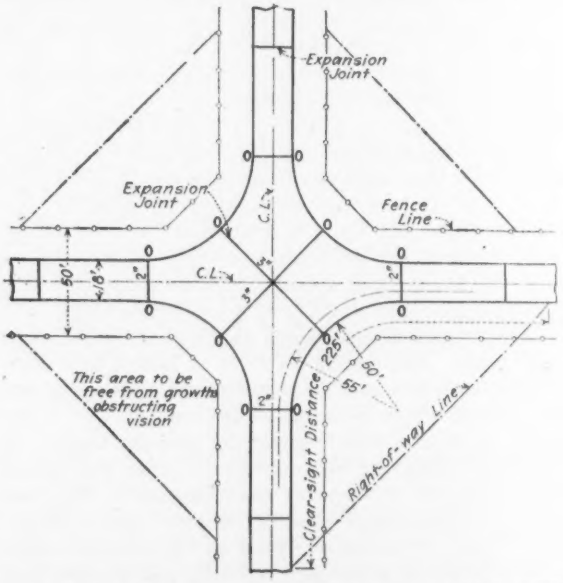
Proper Radius for Turns at Intersection of Highways

Permissible Banking Has Small Effect on Allowable Speed—Number of Automobiles Necessary To Warrant Use of Extra Area

BY G. S. EATON

Assistant Division Engineer, Universal Portland Cement Company

PROPER radius for turns at highway intersections should receive careful consideration. The chief relief from hard turns must come from increased radius, as the allowable amount of banking has small effect upon ease of turning. However, excessive cost for extra paving and right-of-way at long turns should be considered with reference to the extra convenience of the traffic. In this, the number of vehicles passing the point



INTERSECTION PROVIDES ADEQUATE TURNING RADIUS AND CLEAR-SIGHT DISTANCE

is a factor, and it can be shown that the actual saving in gasoline will warrant a change from 20- to 50-ft. radius where 112 automobiles pass, while 171 are required to warrant a 90-ft. radius. Clear-sight distance is also desirable, and an intersection combining ease of turning, clear sight and economy is shown in the illustration above.

The design just mentioned, with the analysis on which it is based, is not given because of its unusualness nor as necessarily the best practice, but rather to serve as an example of the general method of attacking the problem. Credit for the scheme used in obtaining a

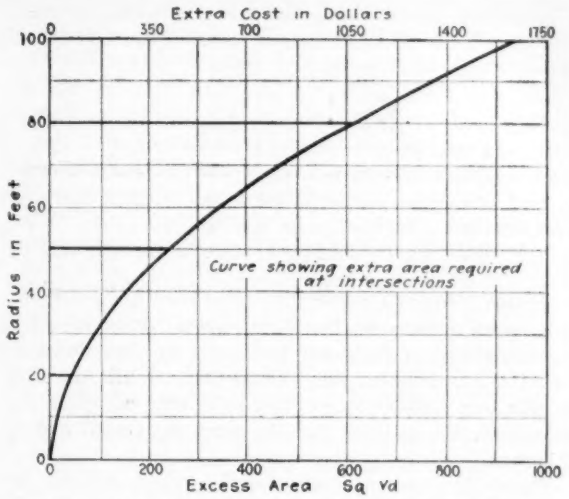
satisfactory clear-sight distance should be given to H. E. Bilger, road engineer, Illinois Division of Highways, whose article entitled, "A Modern Intersection Designed for Paved Highways," appeared in *Engineering News-Record* of July 19, 1917, p. 134. It should be noted, however, that the important distance is the one measured around the curve, which separates two automobiles when they become visible to each other, and is not the length of a straight line connecting the two.

In the article referred to, the design advocated calls for a 125-ft. inside radius, with small unpaved areas near the center. While having many advantages, such a layout would be expensive, and the unpaved areas, if not fully drained, would be dangerous to motorists. If paved with concrete, $1400 would be a low estimate for the cost of such an intersection (exclusive of the area in the straight 18-ft. pavements), while at the same unit prices one built according to the design now suggested should not cost more than $500, allowing $100 for the cost of extra land required, which in each case is less than half an acre. Of course, the turning radius in the latter case is not nearly so great as with the former design.

In order that an automobile may turn without slowing down too much, a turning radius is needed that is more than the few feet which served for horse-drawn vehicles. At any particular speed doubling the radius will halve the centrifugal force, which tends to cause skidding and overturning. Ease in following a curve at a fair speed demands that it be unnecessary to turn the steering wheel too suddenly. Yet economy forbids the use of too great a radius. The rapid increase in paved area, as the inside radius becomes greater, is shown by the curve plotted for various radii.

In the following analysis, an inside radius of 50 ft. was chosen because that will allow a turning radius of at least 55 ft., or even 60 ft., without the automobile getting out of its own track. Reference to the tabulations will show that no trouble should be experienced in rounding such a curve at 15 miles an hour. The centrifugal force developed is about equivalent to that present when making a turn on a 25-ft. radius at 10 miles an hour. With a 90-ft. inside radius, 20 miles an hour should be a safe speed. The plan of flattening the curve near its center was investigated, but with a radius as large as 50 ft. no considerable saving would result from following this scheme, instead of increasing the inside radius.

Superelevating of intersections was another matter carefully considered and then discarded as unwise. On double-track roads, if superelevation is used to help vehicles turning to the right along the edge of the pavement, it will make it harder for the vehicles traveling in the opposite direction, of which an equal number may be assumed. If the turns are banked the dangerous tendency to use the wrong side of the road will be encouraged. When turning on a 55-ft. radius, increase in speed made possible by using the allowable limit of ¾-in. superelevation per foot of width would be small at best. That only 16.6 miles an hour on the banked turn would be permissible, if 15 miles an hour were the safe speed on the flat pavement, is shown by the following example, where the average weight of automobile was considered 2600 pounds. Since centrifugal force varies as the square of the speed it increases very rapidly with the higher velocities.



EXTRA AREA AND EXPENDITURE REQUIRED BY INCREASED RADIUS SHOWN BY CURVE

Centrifugal force $= \frac{WV^2}{gr}$ where W = weight in lbs., V = velocity in feet per second, g = force of gravity and r = radius.

$$\frac{2600 \times 22^2}{32.2 \times 55} = 710 \text{ lb.}$$

Centrifugal force compensated for by ¾-in. superelevation per foot of width = 160 pounds. Total centrifugal force allowable = 870 pounds.

$$870 = \frac{2600 \times V^2}{32.2 \times 55} \text{ or}$$

$V = 24.4$ ft. a second $= 16.6$ miles an hour.

On curves where all traffic is benefited by superelevation and where the radius should be much greater, the advantage to be obtained is worth while; this is not the case on double-track pavements where intersections are entirely paved. How radius, speed and centrifugal force are related is shown in the tabulations as follows:

THE RELATION BETWEEN RADIUS, SPEED AND CENTRIFUGAL FORCE COMPUTED

Turning Radius (Ft.)	Speed (Mi. per Hr.)	Centrifugal Force (Lb.)*	Speed Compensated for by Allowable Superelevation (Mi. per Hr.)
25	8	442	4.8
	10	698	
	15	1,564	
55	10	317	7.2
	15	710	
	20	1,260	
95	15	412	9.4
	20	730	
130	20	533	11.0
	25	836	

* For automobile weighing 2600 lb.

In determining whether an inside radius of 50 ft. or more at intersections would be justified by the resulting saving in operating cost of automobiles, the following assumptions were made: Weight of average automobile with passengers (trucks excluded), 2600 lb.; average car when traveling on level pavement at constant speed can make 17 miles on one gallon of gasoline; cost of gasoline, 23c. per gallon; tractive resistance on level, 30 lb. per ton. Only important loss in power

AMOUNT OF MONEY SAVED BY INCREASING RADIUS

Change in Inside Radius	Change in Speed Made Unnecessary (Mi.perHr.)	*Work Saved (Ft. Lb.)	Saving per Automobile
20–50	10–15	11,387	$0.00075
20–90	10–20	27,330	0.00180

*Allowance made for shortened distances around flatter curves.

is that needed to regain speed after slowing down at intersection.

Work done equals change in kinetic energy; $KE = \frac{1}{2}\frac{W}{g}(V_1^2 - V_0^2)$. With 20 miles as the maximum allowable speed at intersections, the above figures give the amount saved, if it is not necessary to slow down to 10 miles per hour at the intersection. While gasoline is only one factor entering into the cost of operating an automobile, it is by far the most important one in this case.

The daily number of automobiles which will be required to justify a change from 20 to 50 ft., or from 20 to 90 ft., for the radius of the intersection is given below; these values were obtained by dividing the daily cost by the corresponding saving per automobile.

NUMBER OF AUTOMOBILES WHICH MUST MAKE THE TURN TO JUSTIFY CHANGE IN RADIUS

Inside Radius	Permissible Speed (Mi. per Hr.)	Sq.Yd. Excess Area	Difference in Yardage	Total Cost, ($)	*Annual Cost, ($)	Daily Cost, ($)	No. Autos Turning to Justify Improvement
20	10	38					
50	15	238	200	350	30.52	0.0836	112
90	20	773	735	1285	112.10	0.3070	171

* To discharge debt of one dollar at 6% interest in 20 years requires an annuity of $0.0872; this was used in figuring annual cost.

If unrestricted amounts were available for construction, traffic on many main routes would warrant intersections with 90-ft. radii. But inasmuch as funds are usually limited a 50-ft. radius should give a satisfactory intersection at low cost, unless travel is unusually heavy.

War Problems of Water-Works Practically Discussed

Abstracts of Papers and Report Presented at the Win-the-War Meeting of the New England Water-Works Association: Saving Water and Conserving Coal—The Fuel Situation in New England—Detecting Underground Leaks—Thawing Frozen Pipes by Electric Current.

Practical Methods of Detecting Leaks in Underground Pipes

By David A. Hefferan
Superintendent of Water-Works, Milton, Mass.

Abnormal water consumption has prevailed this year on account of water run to waste to prevent freezing during the severe winter weather, and because leaks then created have not yet been stopped. It has been calculated that the elimination of water waste in New England alone would save 150,000 tons of coal a year.

Waste in houses and in service pipes may be curtailed by house-to-house inspection, the use of the aquaphone, on services and work. In distributing mains the problem is different. Given a knowledge of the total volume supplied and various conditions causing legitimate variations in consumption, waste-prevention is largely a matter of detecting and locating leaks.

There are several methods of discovering leaks. The old-fashioned test pit scheme is as good as any, provided the distribution system is well equipped with gates. The test pit is nothing more than a manhole of convenient size built around a valve. On either side of the valve and within the manhole a tap is made and a corporation inserted. This furnishes the foundation for a bypass around the gate. In the bypass a meter is set. If the section is a large one, necessitating a meter larger than 2-in., it is well to make a supplementary bypass with a small meter around the larger one. The section to be tested should be carefully laid out and all gates located beforehand to eliminate delay and tested for tightness.

The test for a leaky valve is simple. Close the gates to be tested and open a hydrant on the line between, removing the suction cap. Then open one valve slightly until the water in the hydrant barrel rises to the level of the suction nozzle and just flows out. Then close the valve again. If the water continues to flow from the nozzle one of the valves must be leaking. Of course, for a few minutes the flow might be from the houses in the district, but this should stop shortly.

If the level of the water lowers it shows a leak somewhere in the cut-off section, below the level of the hydrant nozzle; but it would indicate a good-sized leak, as the open hydrant removes all pressure from the line. Aquaphones may be used on each gate for further tests of tightness. The best hours for the actual testing are from 1 to 4 a.m.

Locating the Leak: A Useful Instrument

If all the gates are tight, it is evident that no water can enter the section so cut off unless it passes through the meter on the bypass. If readings are taken at set intervals and, gate by gate, the area of the section covered by each test pit lessened, it can be seen with ease that the leak will be discovered to be between the two of a certain pair of valves. After its general location has been determined in this manner, the exact point where the water is escaping can be found by looking for any luxurious growth of vegetation at the side of the road, by dampness on the surface of the street, by driving down a bar and noticing any moisture on removing it, by means of an instrument magnifying the hissing sound of escaping water, or by using any other convenient method. In this manner, a whole city or town may be covered.

The instrument just mentioned is contained in a small, light box. A small four-legged brass table is set on the ground over the pipe, where the leak is supposed to be.

The box has a raised bottom so that it may be placed over the table to keep out foreign noises. On the table is a microphone-detector with wire connection to an amplifier battery contained in the box. Very sensitive ear receivers are wired to the battery. When the instrument transmits a rushing noise to the ears it is evidence that the leak is close at hand. The affair is set at different points along the pipe line until the point where the noise is loudest is reached. The leak will be found to be directly under this spot. Used in connection with the wireless pipe locator, it will be found satisfactory.

The beauty of the test-pit scheme is that it is permanent. The pits are always ready for use in time of need. If it is not desired to construct the manholes the same results may be obtained by connecting two hydrants with fire hose, one hydrant being inside and the other outside the section to be tested.

Other Methods of Leak Location

Another method, quite as accurate, but probably more complicated and requiring more delicate apparatus, is the use of the pitometer. There are also several special methods. One, called the caustic soda method, was described at a meeting of the New England Water-Works Association some years ago by F. J. Hoxie. Another is a special device making use of water hammer. It works on the principle that the sudden closing of a valve produces an impulse which travels through the water in a wave, decreasing in intensity in passing an opening in the pipe. It is asserted that the relative distances from the instrument to the break and to the suddenly closed valve are readily determined, but with what accuracy I cannot say.

From our experience in Milton, we believe the test-pit method to be as accurate as any and simpler than most. It proved its value this spring when we found our daily consumption, which had been away above normal all winter on account of water being run to prevent freezing, was not at all reduced when mild weather set in. We were using at the rate of 500,000 gal. daily, which was 56% above normal. The leak was discovered in short order, the average daily consumption was reduced 180,000 gal. and the night flow was reduced from 20 gal. to 10.

Saving Water and Conserving Coal

By George W. Carpenter
City Engineer, Pawtucket, R. I.

REDUCING to a reasonable figure water consumption in cities which have high per capita averages would save far more water than would a small horizontal cut in all cities. In the absence of any considerable volume of data throwing direct light on the question in hand, the author has used 1915 water consumption statistics of the United States Bureau of the Census as a basis for computing possible coal saving by reducing water consumption.

Statistics for 155 cities owning their works showed that for a total population of a little more than 25,000,000 an average of 3,748,000,000 gal. of water was supplied in 1915. The report states that 80% of the water supplied is pumped and that 80% of the pumping, or 64% of the total, is done by steam power—about 114 gal. per capita per day. The average horsepower of the pumps per million gallons capacity is given as 36.

Assuming a saving of 64% of 26,000,000 gal. daily (10 gal. per capita), an average of 36 hp. per 1,000,000 gal. pumped against a head of 207 ft., and a coal consumption of 2 lb. per horsepower-hour, we find that 14½ tons of coal could be saved daily by a reduction of 1 gal. per day in the per capita consumption. This would be approximately 5200 tons of coal a year, or 52,000 tons if the per capita reduction were 10 gal. per day. Can water consumption throughout the country be reduced 10 gal. per capita per day? Yes, that amount and more too, on the average.

Tackle the Heavy Water Wasters First

The writer, however, does not believe that this saving should be made by a *uniform reduction* of all consumption, regardless of present rates, for there are many cities that have already reduced water consumption to a very low figure, while others are wasting water in a prodigal manner.

An examination of the tabulated statistics of 148 of the cities reported, representing a total population of 25,644,000, indicates a daily per capita consumption varying from a minimum of 34 gal. for Woonsocket, R. I., to a maximum of 324 gal. for Buffalo, N. Y.

Of the 150 listed in the Census Report of 1915, 55, representing a total population of 4,590,000, now have an average per capita consumption of less than 100 gal. per day, and 88 cities, with a population of 14,546,000, have an average of 125 gal. or less per day. If we assume that 125 gal. per capita daily is a reasonable allowance, we find that 48 cities could save a total pumpage of 663,000,000 gal. daily, and that of this total Chicago alone could save 37% by reducing its present consumption of 226 gal. per capita per day to 125 gal. The four cities of Chicago, Philadelphia, Pittsburgh and Buffalo, with respective averages of 226, 182, 252 and 324 gal. per capita, could save 495,000,000 gal. per day, or nearly 75% of the total.

If we make the same assumption with respect to the 663,000,000 gal. that could be saved by the 48 cities referred to—namely, that 80% of the pumping is by steam power, we have a total of 530,000,000 gal. pumped by steam; and by applying our previous assumption as to the use of coal to pump this amount of water, we have a possible saving of 458 tons of coal per day, or 32 times as much coal as could be saved if *all cities* reduced the per capita consumption by 1 gal. per day. A saving of 458 tons daily is about 167,000 tons annually. Chicago, Philadelphia, Pittsburgh and Buffalo could save about three-quarters of this, or 125,000 tons, by a reduction of the average per capita water consumption to a figure already reached or improved upon by 88 of the 148 cities reported. If we assume a per capita allowance of only 100 gal. daily a very much greater saving of coal can be made.

Pump Slip Should be Reduced

The writer believes, however, that a reduction of consumption to reasonable limits is not the only objective which should be sought in order to conserve fuel. Pump slip is often a source of an enormous waste of power. We often find reports where total consumption, engine

duty, etc., are figured to all manner of degrees of precision, only to discover, upon critical inspection, that all these figures are based upon plunger displacement, with no knowledge of, or attention paid to, the probable slip.

Referring to the figures previously used, 3,748,000,000 gal. pumped daily by 155 cities in this country, and calling 80% of this pumped by steam, we obtain 3,000,000,000 gal. If we assume a slip of 5% only, and use our previous figures of 36 hp. per million gallons and 2 lb. of coal per horsepower-hour, we find that this slip is equivalent to the wasting of 130 tons of coal per day or nearly 50,000 tons per year. This is about as much fuel as we found would be saved by reducing the average per capita consumption of the 155 cities previously cited by 10 gal. per day. If we stop to consider that in many pumping plants the reducible slip is probably greatly in excess of 5%, we may realize that one profitable field of investigation may lie very close to the pumping station itself.

Unfair Burden on the Conscientious

To assume, however, that conservation of fuel can be obtained by a *uniform reduction* of the per capita consumption of water throughout the United States, without first giving wide publicity to the wastefulness existing in certain cities, is unfair to those cities and officials now using every effort to keep water consumpton within reasonable and proper limits and conserve and increase pump efficiency. It will furnish one more example of the faithful, conscientious citizen hastening to do his "bit" and carrying also the additional burden caused by the thoughtless extravagance and wastefulness of those who will not or do not care.

Never in the history of the world has the absolute dependence of one nation upon another, one community upon another and one individual upon another been recognized as it is today. This world war has brought home to thinking minds a realization of individual responsibility, of the necessity of unity of purpose, and of individual sacrifice for the common good, that could have been produced in no other way.

To-day, therefore, is an opportune time to bring to the attention of those cities whose prodigal use of water amounts almost to a crime the fact that such wastefulness is far-reaching, that its effect extends beyond the borders of the city itself and may reach even across the seas, tending to withhold from those brave men upon whom civilization now depends for its existence the arms, ammunition and supplies needed in its defense.

The Fuel Situation in New England

By Charles T. Main
Consulting Engineer, Boston

THE bituminous coal needs of New England for 1918 were estimated at 33,400,000 tons by the New England Fuel Administration. The United States Fuel Administration estimated the needs as 30,000,000 tons, but later cut it down to 25,000,000 tons. Present indications are that there will be a shortage of at least 6,000,000 in bituminous coal and that New England will get about its usual allowance of anthracite. Storage has been limited to 60 days' needs.

New England could get along with less coal by shutting down the less essential industries, but this should be the last resort. Oil as a substitute presents transportation difficulties and at present fuel-oil companies will not take more contracts. Wood could be made to help out. Hydro-electric companies in Massachusetts are fully loaded. Many of the water-power plants in New England could be improved and increased in capacity in a reasonably short time. The most promising immediate method of getting along with less coal is to study various possible losses and reduce these to a minimum.

A Fuel Saving Committee for Each Plant

A plan which is being urged is the setting up of a fuel committee in each establishment where fuel is consumed, to see that fuel is conserved and steam not wasted. An advisory engineering committee has been formed to visit local plants and give advice. This committee has issued a bulletin of coal-saving suggestions. In addition, a bulletin has been prepared by a committee of firemen and engineers for men of their class. These bulletins may be obtained from the Massachusetts Fuel Administration, Boston. Every water-works plant using coal or other fuel might well establish a fuel and power committee from among its own men.

Electric Thawing of Frozen Water Pipe

From Report of Committee on Frozen Water Pipes.
Frank J. Gifford, Chairman, Dedham, Mass.

THAWING frozen water mains by electric current was the method commonly employed, according to reports from a considerable number of works obtained by the committee on frozen water pipes, of which the writer was chairman. Current from lighting wires, portable motor-generator sets and storage batteries was used.

The method best known and most generally used was connecting with the overhead wires of the lighting companies. In this type the high-tension primary wires, carrying 2200 to 2400 volts, were tapped, and the current was carried to cut-out boxes with suitable fuse wires. From the fuse boxes the wire ran to one or more transformers whose capacities ranged from 15 to 75 kw. In a large majority of cases the voltage was reduced by the transformers to 110, and the amount of current delivered upon the pipe was further controlled by the use of a water rheostat.

Motor Generators on Trucks

The motor-generator set was used to a considerable extent. One outfit consisted of a 25-volt, 250-ampere, direct-current generator, equipped with a volt-meter, an ammeter and an automatic circuit-breaker, mounted on a motor truck. On the truck was also mounted a countershaft carrying a sprocket wheel at each end, and a driving pulley which was connected to the generator by means of a leather belt. On each side of the jack-shaft of the truck was attached a new sprocket wheel just outside of the existing driving sprockets. Upon arrival at the point where the work was to be done the chains were taken off the driving sprockets and attached to the new sprockets at the jack-shaft and

to those on the countershaft mounted on the truck. The motor truck engine was thus utilized to generate the required current.

A limited use was made of the storage battery. One outfit consisted of three trays, each containing eight 2-volt cells, so connected up that a voltage of 16, 32 or 48 could be obtained. Another of six trays of four 2-volt cells each was still more flexible, as voltages of 8, 16, 24, 30, 36 and 42 were possible. Another of six trays of three 2-volt cells was connected in multiple series, giving a voltage of 35. This outfit proved unsatisfactory, as serious damage was done to the pipes in a number of cases.

The properly connected storage battery has proved very efficient. Like the motor-generator set, it is flexible and portable, and when operated by an experienced man the method is safe. If it is improperly used, damage to the pipes and to the battery itself can result easily. The batteries must be recharged after a continuous day's use, the operation taking eight hours. The storage battery is delicately constructed and can be easily damaged both in discharging and in recharging. It deteriorates when not in use, especially during the long period of the year when it is not needed.

While available data are to some extent conflicting, and more exact information is desirable, yet general experience shows that for the work of thawing $\frac{5}{8}$-in. lead or $\frac{3}{4}$-in. iron service pipes of average length, using 4/0 wire for leads, and with good connections, the following figures may be considered as approximately normal: Drop in pipe, 14 to 18 volts; total voltage required, 20 to 30; amperes required, 175 to 225; time required to thaw, 6 minutes, plus or minus. With larger pipes, or with pipes longer than the average, of course more electrical energy and time are required.

For all-round, efficient, economical work the committee looks most favorably upon the motor-generator set. It is flexible, can be taken where the work is to be done, can work continuously, does not deteriorate when not in use, can be made almost fool-proof, and, if properly designed, is the safest type of apparatus from the point of view of avoidance of danger to the water pipes.

Peak Run-off Data on Restricted Dry-Wash Channel

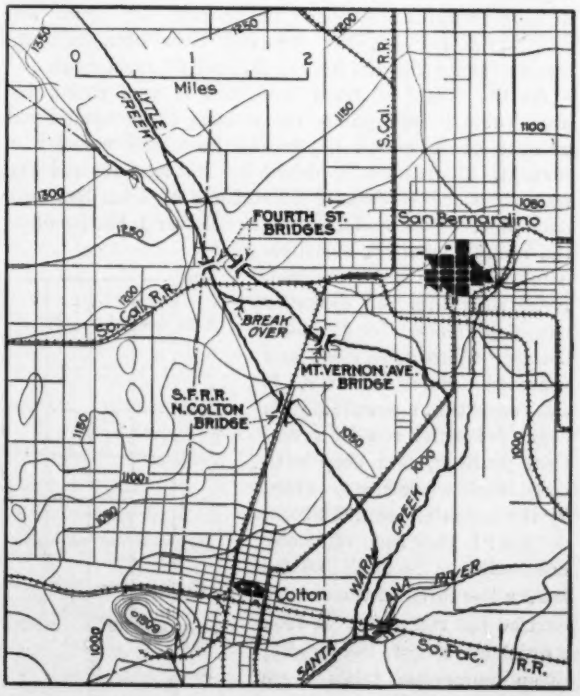
Sounding Rod Thrown Forcibly from Bridge Into Swift Current to Measure 18-Foot Velocities at Ten-Foot Depths

ENCROACHMENT upon the dry-wash channels of southern California streams, all appropriated normally for irrigation, is a great temptation to land owners, particularly in the orange belt, where land values are high. For this reason, data on the run-off during extreme floods are particularly valuable. In many of these streams the dry-wash area is being restricted to narrower and narrower limits, so that this peak run-off may cause great damage. Little is known as to the actual flow of these peaks, so that records taken at Lytle Creek in January, 1916, and recently made available, are both valuable and interesting. Although the records were made under difficulty, one of the bridges from which the gaging was done being washed away, an almost complete curve was obtained by the promptness of the engineers rushing to two lower bridges.

Lytle Creek is the most important single tributary of the Santa Ana River, and has its source in the San Bernardino Mountains near the foot of Mt. San Antonio. After 17 miles of cañon the stream spreads out in an erratic course across the foot hill mesa land to a point seven miles below the mouth of the cañon, where it is joined by a smaller stream, Cajon Creek. Thence it continues down the San Bernardino Valley, dividing into branches flowing respectively through San Bernardino and Colton, and continuing for eight and nine miles across the valley to the Santa Ana River.

Property directly affected is valued at about $30,000,000, and the property and damage loss by the flood of 1916 was in excess of $100,000. The problem of flood control has repeatedly been under consideration, but has not taken definite form until recently.

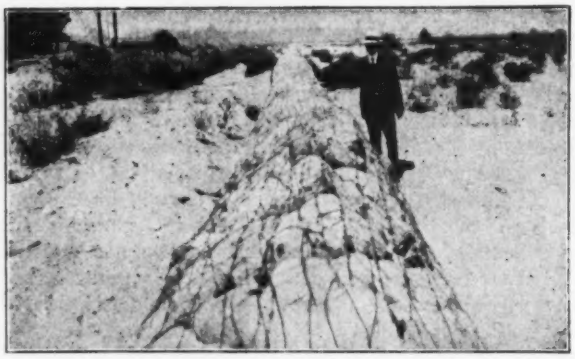
By a combination of careful planning and fortuitous circumstance, the "big flood of 1916" was caught at its inception and was followed by careful measurements, taken four or five times a day and two or three times a night, until it subsided. The bridge station on West Lytle Creek went out during the second rise of the flood, on Jan. 18, and it seemed for a time that the records might be broken at the very peak of flood. By making hurried use of two other stations, 1½ miles downstream, and of a third of the old Fourth St. bridge on East Lytle Creek, the records were kept uninterrupted, and an actual measurement of flood



ON FAILURE OF FOURTH STREET BRIDGE, ENGINEERS TRANSFERRED GAGINGS TO LOWER BRIDGES

flow was obtained within a few minutes of the maximum peak of flood.

Channel measurements were made by the common use of sounding rods, this being rendered possible by the unusually low clearance of bridges. For the first low flood measurements, an ordinary 10-ft. cross-sec-



FLEXIBLE TRAINING WALL OF CABLES AND HOG WIRE RESTRICTS FLOOD ENCROACHMENTS

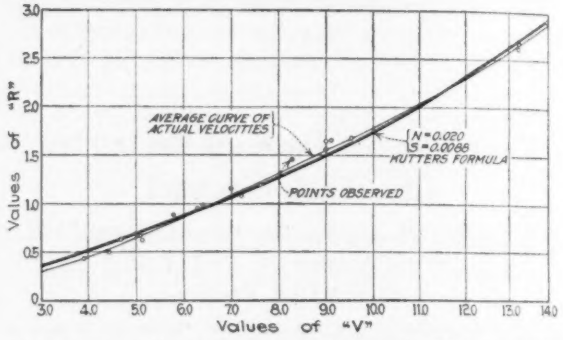
tion rod was used. Depth measurements were taken at 3-ft. intervals across the channel, measuring the depth below the top of parapet wall on concrete bridges, or below the top of bottom chord on steel or combination bridges. The first set was taken to the surface of the water, then a set to the bottom of the channel and a third set to the surface of the water. Velocity measurements were then taken at intervals across the channel, and then another group of depth measurements, taken in three sets as before. By this means the actual mean section was determined for which the measured mean velocity was applicable. Later it was found advantageous to reverse the process, taking first one set of measurements for velocity, then one for depth and finally another set for velocity, thus obtaining the mean velocity for the actual channel measurement.

As the stage of flood increased it was found impracticable to manipulate the wooden cross-section rod, because of increased depth and increased velocity of current. Acordingly, a measuring rod was devised that was composed of three 8-ft. sections of 1-in. wrought-iron pipe. This was marked in feet and tenths along the section where a measurement reading was required. Even with this rod difficulty was experienced in touching bottom. With experience and repeated trials, however, it was found that a powerful man could poise the rod in a vertical position, and then with considerable exertion, aided by the weighted lengths above, so h u r l the rod vertically downward as to catch bottom before the force of the stream carried the rod away. It took a quick eye to note the height; often numerous trials were made before the deep parts of the channel were gaged.

Use of a weighted line was not reliable, as the velocities of flow ranged from 10 to 18 ft. per second. Trials were made, but a weight which one man could handle was not heavy enough to carry the line down at a lesser angle than 30 to 45°. Even at that the weight carried downstream rapidly until the tension on the line, combined with the velocity of the current, lifted the weight from the bottom of the stream.

The rod method was at first scouted as impracticable, but by careful manipulation and considerable hard work it was made a success. Maximum depths of 10 ft. were thus measured in water flowing at an average velocity of 18 ft. per second. This record is believed to be unusual for water of such high velocity and carrying large quantities of stones and débris.

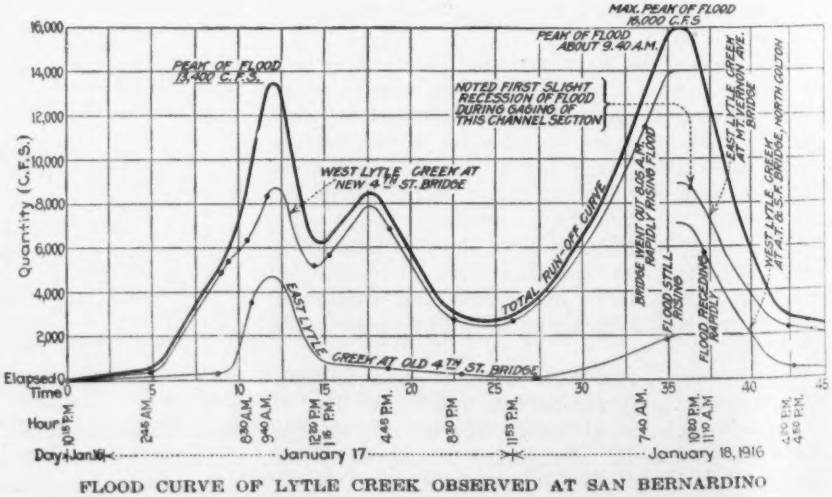
The typical velocity curve, as determined for the West Lytle Creek channel at the West Fourth St. bridge, is shown on the accompanying chart, which



COMPUTED AND OBSERVED VELOCITY CURVES ON WEST LYTLE CREEK AGREE

shows also a dotted line plotted from Kutter's formula with $n = 0.020$. The close agreement of these two curves is rather unexpected. It would have been thought, from the condition of the channel, that a closer agreement would have been found with the curve for $n = 0.025$.

One of the interesting checks found in taking these measurements was with regard to the ratio of depth of scour to height of rise of water. It was found that very nearly the same curve was followed by these two, the average depth of scour being slightly more, and



FLOOD CURVE OF LYTLE CREEK OBSERVED AT SAN BERNARDINO

closely equal to, the height of stage above average low water.

Lack of sufficient rainfall stations in the Lytle Creek watersheds made it impossible to compare rainfall and run-off data for this flood with any degree of accuracy. Additional rainfall stations have been established, so that a fair average rainfall can now be determined.

This work was carried out under the general direction of J. A. Sourwine, county engineer, San Bernardino County, now a captain in the Engineer Officers' Reserve Corps.

Submerging Bed With Sewage Kills Sprinkling Filter Fly

Larvae and Pupae Destroyed by 24 Hours' Flooding at Plainfield, N. J., Without Materially Injuring Filter Bed

By Dr. Thomas J. Headlee and
Charles S. Beckwith
Agricultural Experiment Station, New Brunswick, N. J.

DROWNING has been proved effective where chemicals failed to control myriads of small grayish to white moth flies at the sewage sprinkling filters of Plainfield, N. J. The problem was brought to the attention of the senior author by the controlling committee of the sewage-works.

Psychoda alternata Say, or the sprinkling sewage filter fly, as we have named it, bred in enormous numbers at this filter plant and was found to rise and fly or be wind-carried for distances as great as ¾ mile. Its small size (3 to 5 mm. long) enables it to penetrate even the finest screen and thus infest the houses of persons living in the neighborhood. It lodges on and in foods and has been charged by the neighbors with the carriage of infections resulting in serious sicknesses.

While investigations made to date show no basis for the assumption that infections are carried by the fly, the belief in the possibility is quite sufficient to entail law suits and to give the committee controlling the operation of the plant a great deal of concern.

A study of the problem showed that this insect bred on the sprinkling filter bed throughout the entire season, and that while there was no trouble from flies during the cold months, they were present on the filter in the larval and pupal stages throughout the winter. The abundance of the flies during the warm season seems to be correlated with the thickness of the film on the stones of the filter. A thick film means more flies and a thin film means fewer flies. It seems that the heavy furry film of late spring gives rise to a tremendous brood, that the sloughing-off process or unloading of the film which follows results in a great reduction in the number of flies, and that the thickening of the film in late summer is again accompanied by the production of an enormous number of flies. Examination of the literature relating to this subject indicates that these flies are practically always developed where sprinkling sewage filters are installed.

A study of the problem showed that under a temperature of 70° F. the fly requires from 11.17 to 19 days to complete its entire life cycle, distributed as follows: Egg stage 32 to 48 hours, larval stage 9 to 15 days and pupal stage 20 to 48 hours. These determinations were made under controlled temperature conditions, and the change in position of the stone on which the immature stages were located might either shorten or lengthen the period. It seems probable to us, however, that the effect of artificial conditions was principally shown in the variation in length of time above indicated. On the filter beds the completion of the life cycle may require much more time in lower temperatures, or considerably less time in higher temperatures.

The study demonstrated that the control of the pest by the destruction of the adults was impracticable and that the attack must be made during the immature stages. The study also showed that in the larval and pupal stages the organisms live embedded in the film and that during both stages they thrust their breathing tubes through this film to obtain atmospheric air. The problem of control was thus resolved into one of finding an agent which would destroy the larvae and pupae and not injure seriously the film on which the efficiency of the filter bed depends. A large number of chemicals were tried. Any of these, when used in strength sufficient to kill the fly, also damaged the film.

Hypochlorite of lime received a rather thorough trial. Twelve pounds of this substance applied at the plant through the dosing tanks on one day, and repeated the second day after, caused 60% of the larvae to disappear. This treatment was followed by the sloughing of a considerable portion of the film in the upper layers of the filter. Similar tests were made with 15, 30 and 50 lb. per acre and the kill was still incomplete. The final test was made by using the hypochlorite of lime for the dosing tanks at the rate of 50 lb. per acre, applied three days in succession. About 85% of the maggots disappeared from the beds, and many as they appeared in the final tank were found to be alive. Following this last treatment the sloughing of the film was very marked.

Being unable to complete certain laboratory studies of the living larvae and pupae before leaving the office, the senior author, intending to continue the study on the next day, covered the material with water. When he again attacked the problem the following day he found that all the larvae and pupae were dead, although other active constituents of the film seemed to be in good condition. This led at once to the test of submergence as a means of destroying the insect. The accompanying table serves to show the results of three sets of experiments.

To make the matter more certain one-fourth of the Plainfield sprinkling filter, amounting to a little less than ½ acre, was submerged for a period of 24 hours with the ordinary sewage water as it came from the

RESULTS OF SUBMERGENCE TESTS ON SEWAGE SPRINKLING FILTER FLY

Length of Time Flooded, Hr.	Condition of Larvae and Pupae.	Condition of Film.
16	Alive	Alive*
18	Alive	Alive
22	95% dead	Alive
24	Dead	Alive
32	Dead	Alive
36	Dead	Slight putrefaction
48	Dead	Putrefaction

*Organisms which largely compose the film alive.

dosing tanks. At the end of this period the water was released and many samples were taken. Enormous numbers of larvae and pupae came out with the water, and not one could be found that was alive. Tests of the effluent made by John R. Downes, superintendent of the plant, for a period of one week after this submergence, showed no decrease in the efficiency of the treated portion of the filter. We are, therefore, led to conclude that the sprinkling sewage filter fly, *Psychoda alternata Say*, may be destroyed by the simple process of submerging the sprinkling sewage filter bed with the ordinary sewage water for a period of 24 hours, without in any way seriously damaging the film or interfering with the efficiency of the bed.

Engineering Supervision Improves Water-Distribution System

Plans, Estimates and Progress Records Are Made; Flow and Leakage Tested; New Devices and Methods Proposed

EFFICIENT and economical operation of the water-pipe extension division of the Department of Public Works, Chicago, is facilitated by a special engineering section, as part of the organization described in *Engineering News-Record* of May 9, p. 921. The duties of this section include the preparation of plans, estimates and orders for all work done by the construction forces of the division; the supervision of work in progress and the keeping of records of work; also the testing of flow, pressure and leakage in mains. For this work the city is divided into three districts. As explained in the annual report of the department, each district is in charge of an assistant engineer having three field parties, engaged on construction, street improvement and feeder main surveys, respectively.

Each construction party, consisting of a junior engineer and one rodman, is required to set line and grade stakes for all contract and many city pipe-laying jobs; also to visit jobs in progress and keep a record of the locations of pipe and fittings. This information is used to check the foremen's reports on the jobs and to furnish correct sketches of work done for plotting in atlas records. The party spends considerable time in making inspections on other construction work, such as large sewers, gas mains and track elevation, with a view to protecting the water mains and making recommendations for necessary changes. All of the large feeder mains put in service during 1917 were treated with chlorine by the construction party.

The street improvement party, consisting of a junior engineer and two rodmen, with the necessary laborers, makes tests and investigations on all streets that are to be paved. The results of these tests are the basis of recommendations for work to be done by the district force in order to put the system in good condition and prevent future maintenance expense.

The feeder-main survey parties during 1917 covered practically the entire feeder-main system with flow tests, furnishing data for ascertaining the operating condition of the mains and for planning improvements to the system. Closed surveys were made in some sections and the per capita and peak-load consumption determined. Pressure curves were furnished to the pumping stations to indicate the necessary pressures to be carried at the station in order to obtain satisfactory pressures at remote points on the system. Continual study was made of the pressure conditions as indicated in the daily pressure charts received from the recording gages at various points.

Important work was performed by the feeder-main parties of the central and north districts to conserve the supply in the vicinity of the Springfield Ave. and the Central Park Ave. pumping stations and thereby relieve the low-pressure conditions in Austin. The water department was thus able to increase the pressure at the pumping stations and give better pressures.

In the district supplied by the Roseland station, studies of the feeder-main parties indicated there was an excessive use of water, due to high pressures in some sections. Through recommendations of the division engineer and coöperation on the part of the operating division and the engineer of pumping station efficiency, an operating program was worked out for this station whereby it was able to supply a larger territory and at the same time increase its efficiency.

Analysis of cost of work was the subject of a report which suggested new forms of reports for assistant foremen and new methods of checking costs. A report recommending an improved and standardized design for roundway cocks and shut-off boxes led to the passage of an ordinance establishing this standard. It is proposed to have these articles made or purchased by the city and furnished at cost to plumbers. H. L. Lucas is superintendent and R. S. Spalding is engineer of the water-pipe extension division, under John Ericson, city engineer.

Sand Streaks on Concrete Caused by Boiling Up of Excess Water

Excess mixing water seeking a means of escape causes the sand streaks or "sand showers" appearing on the surface of concrete walls. This fact was established by observation by a concrete foreman on lock wall construction at Troy, N. Y., as reported in *Professional Memoirs* for July-August by D. A. Watt, assistant engineer. Sand streaks usually appear as fan-shaped areas, widest at the top, where the sand aggregate shows uncovered by cement but held just like the sand on sandpaper. Their unusual prevalence on the lock walls led to careful observation. Little ebullitions of water from down in the mass to the top surface were observed. The phenomena were not confined to the surface against the forms but occurred at various points in the mass. The escape of the water was through fissures or holes not larger than a pin head. Flow would continue for a minute or so, and when it stopped a small flat cone of cement would be left upon the surface. Apparently the weight of the concrete forced out the excess water which sought escape by boiling up through the concrete and so carried some of the cement with it. This probably accounts for the fact that no cement is found along the sides or at the bottom of sand streaks as they appear when the forms are removed. The sand streaks at Troy were much more noticeable when steel forms were used, their smoother surface apparently offering less resistance to the movement of the water.

Contract Organization Vitally Important for War Work

Large-Scale Government Construction Demands Most Careful Co-ordination of Forces —Charts Set Forth Organizations for Two Typical Contracts

By Francis Donaldson
General Superintendent Empire Engineering Co., Inc., New York City

LIKE every other phase of man's activity, the business of construction has been much affected by the great war. America's entry into the struggle has demanded the building of great camps, shipyards, marine terminals and ammunition plants on a scale and at a rate of speed never before equalled, in the face of constantly changing conditions and rapidly increasing costs. The Federal Government has called upon the contractors of the country to do these things and the contractors are meeting the test, not only by doing them quickly but by developing new methods and new plans of organization to do them effectively. The importance of organization cannot be too strongly emphasized.

The most radical change from the ordinary performance of Government work was the adoption of the cost-plus-bonus form of contract, first by the Cantonment Division and afterward by other branches of the Government in charge of war activities. Without considering the question of whether, under ordinary conditions, this form of contract is as satisfactory as the unit-price or lump-sum form, it is obvious that in war time military works must be well under way before the plans can be completed, and important changes in quantities or design or both must be possible without altering the contract or opening the door for claims. This the cost-plus-bonus contract accomplishes.

Because large numbers of men have to be quickly got together and put to work and vast quantities of materials handled, and because everybody knows "Government money" is being spent, more elaborate organizations are necessary than are ordinarily employed; the features that in ordinary construction work are most important and are first attacked become secondary, and other problems become vital and should receive precedence. The contractors who recognized this in advance were successful, while those who started their jobs along customary lines were never able to catch up with the development of the work and failed to show even moderate efficiency. Transportation and housing the workmen, keeping their time and paying them off, and unloading and distributing construction material are all questions to which too much attention cannot be paid.

Definite Responsibility and Definite Authority

Of course, the basic principle of organization applies to all work, big or little, hurried or otherwise—definite responsibility and definite authority. The difficulties begin in distributing the authority and making the responsibility "stay put" in handling thousands of men and countless trainloads of material. It is easy to sit down and on paper divide the work into a series of departments along the general lines adopted by many large and efficient manufacturing plants, but it is next to impossible on a large job to make these departments function without interference or lost motion. They are of necessity built up hurriedly of men who are largely unacquainted with one another and with the limitations of their work. This acquaintanceship is the foundation of efficiency in a departmental system, and in a factory is acquired gradually and thoroughly. In construction work, on the other hand, employees of different departments working on the same part of the job will either interfere or leave gaps in the work through which efficiency is lost. Infinite opportunity is also afforded for "passing the buck." Theoretically, this can be prevented by proper coöperation between the department heads, but they cannot be everywhere at once, and, at any rate, perfect coöperation is a great deal to expect. The constant change in its requirements for labor and materials due to its own growth is the point where most construction work differs inherently from manufacturing, and it is the insufficient recognition of this that has caused the failure of many pretty schemes laid out by efficiency engineers successful in other fields.

Fewest Possible Steps

The form of organization best suited to contract work in general, and more particularly to the big "hurry up" jobs of which this article treats, is one with the most definite assignment of responsibility and the fewest possible steps. This is secured by a divisional rather than a departmental system, with a superintendent in complete charge of each geographical division reporting to the general superintendent of the work. The divisions should be small enough to enable the superintendents to supervise in person the foremen directing the activities in their division. Such a plan may result in some duplication of effort, and it does not tend toward standardization, but the loss in these respects is far more than offset by the increased sense of responsibility and interest felt by the divisions. If standardization of certain features of the work is desirable it can be secured by the general superintendent acting through the division superintendents, or by assistants to the general superintendent appointed by him to follow up such features. While absolute sectionalization is impossible on most jobs and certain general departments are essential, the work allotted to the departments should be minimized rather than emphasized.

A case in point is that of a large waterfront plant built in the past year. Here the greater part of the work was performed by subcontractors, each building a geographical section of the whole. In order to obtain through the Government the chief materials of construction, a central purchasing department was established. This department, however, did not confine itself to materials of construction, but was empowered and required to buy everything used on the job. To buy wholesale and distribute to eight or ten contractors the million and one small tools and supplies needed in starting eight or ten big jobs at once is a task that would tax the ability of the best-run contractors' supply house

in existence, and it was one that no newly organized stores department could hope to cope with. Although it is likely that tools and supplies were bought more cheaply than the contractors' buyers could have done in competition with one another, the time lost by the contractors in not being able to get what they wanted when they needed it much more than offset this gain.

A similar difficulty was caused by a general labor department organized to handle all matters connected with obtaining and employing labor; all men hired by the contractors direct had to be brought in through and formally employed by the general department, and so many errors and misunderstandings arose that a large part of the advantage due to the contractors' ability to get satisfactory men for their own work was lost. In both instances the contractors felt that they were being hindered by the department, and whether or not such a feeling was justifiable, its very existence detracted from their energy and initiative and thus hurt the work. The trouble might have been obviated by utilizing the departments to coördinate the work of the contractors' buyers and labor scouts, rather than to attempt to take it out of their hands.

The accompanying organization charts are more or less composite, but they approximate those developed

Chart I—Construction of Cantonment

On this work the design, field engineering and inspection, checking of materials, timekeeping and auditing of vouchers were performed by the Government direct and in consequence these functions are not covered by the chart. Roads and exterior lights and power circuits were constructed under separate contracts. Interior lighting, plumbing and heating were sublet.

GENERAL MANAGER

- **Financial Manager**
  - Auditor
    - Accountants, bill and voucher clerks, cost records
  - Chief Paymaster
    - Division paymasters and clerks
- **Chief Engineer (equivalent to works manager)**
  - Office engineer
    - Estimators of materials
    - Engineers of materials distribution
    - Draftsman on construction methods
    - Plan file
  - Purchasing agent
    - Buyers
    - Chief storekeeper
  - Traffic manager
    - Expeditors
    - Local car movement chasers
    - Car record clerks
  - General superintendent
  - Assistant general superintendent
    - Assistants to general superintendent
    - Superintendent of employment
      - Labor scouts
      - Employment record clerks, messengers
    - Superintendent of sewer and water systems
    - Assistant
      - Field engineer of sewers and water
      - Superintendents of sections
        - General foremen of excavation
        - General foremen of pipe laying, sewers
        - General foremen of pipe laying, water
      - Storekeeper and clerks
    - Superintendent of distribution
      - General foreman of trucks and teams
        - Foremen
        - Expeditors
      - Record clerks, truck and team time
      - Record clerks, material distribution (distribution clerk)
  - Mechanical engineer
    - Foreman of repair shop
    - Foreman of temporary water system
    - Clerks and storekeeper
  - Superintendent of building construction, section 1 (work divided into about 15 sections with identical organizations on each)
    - Assistant in charge of material
    - General carpenter foreman
      - Foreman of sawmill
      - Carpenter foreman
    - General labor foreman
      - Labor foreman
    - Clerk and storekeeper
- **Subcontractor—Interior Lighting**
- **Subcontractor—Plumbing and Heating**

GENERAL—At the cantonments the construction of the buildings themselves could, in general, progress without regard to the utilities. Plumbing, heating, lighting, etc., followed the construction work without interference. The work of building construction, therefore, was divided into sections of a pproximately equal size (about 2,000,000 ft. b.m.) with similar organizations, each under its own superintendent. As the building lumber arrived at a central yard, a single unloading and hauling organization was needed to distribute it with reasonable fairness. The water and sewer division under a single head was also divided geographically into several sections, each under its own superintendent. In general the subcontractors installing plumbing, heating and lighting followed the same plan.

DESIGN—All designs furnished by Government. Plans issued received by office engineer and recorded, filed and reissued by him.

FIELD ENGINEERING—All field engineering, inspection and measurement of work done performed by Government.

SCHEDULES—Schedules were made up by the chief engineer and distributed to the departments as he saw fit. Schedules were little used in ordering material, as the job had to be done in so short a time that the earliest possible dates of shipment were hardly soon enough. All material was ordered as quickly as the quantities could be computed and the orders placed. Progress records were kept by the Government field engineer.

PURCHASES AND STORES—Requisitions for construction materials originated with the office engineer, whose duty it was to estimate quantities required and rates of delivery; then went to the purchasing agent, who placed the purchase orders and received notice of shipment. Requisitions for supplies originating in the division were signed by the division superintendents and forwarded through the chief storekeeper to the purchasing agent. Division storekeepers reported directly to the division superintendents, but were under the control of the chief storekeeper as regards reports of supplies received and on hand. Subcontractors could purchase their own supplies direct, but were required to forward a copy of each order through the chief storekeeper to the purchasing agent. All orders for supplies called for delivery at the division storehouses. The normal function of the chief storekeeper was to keep in touch with the stock on hand at the various storehouses, to supervise requisitions and generally to act as a clearing house for supplies.

EQUIPMENT—Plant and equipment were bought or leased by the purchasing agent under the direction of the chief engineer.

MATERIAL CHECKING—Checking and auditing were performed by the Government. Approved bills were turned over to the contractor's auditor for vouchering and payment.

TIMEKEEPING AND PAY ROLLS—Time was kept and pay rolls were made up by the Government. Rolls closed Saturday and were turned over to the contractor for payment the following Saturday. The timekeeping method used required all employees to carry metallic checks. The series of checks allotted to each division was given a distinguishing letter and numbered serially from 1 up. Employees were in general required to check through their division time offices at the beginning and end of each shift and in addition were field checked twice daily by time checkers; the time office check was omitted, however, when men were working so far away that they would lose time in going back and forth. Foremen were required to turn in to division time offices at the end of the shift daily time reports showing the numbers and time of the men working under them, and the pay roll clerks were required to compare these with the checkers' reports before entering time on the pay roll. Different grades of employees were given different series of numbers (as 501 to 1000 for common labor, etc.) at the discretion of the division timekeeper. Foremen, however, were numbered 1 to 100 on all divisions.

EMPLOYMENT—The employment office was required to register everyone seeking employment and to assign workmen to the different divisions of the work as directed by the general superintendent. After registration each man was given a dated employment card, was taken by messenger to the division to which he was assigned, and was checked in. The timekeeper assigned him a number, wrote it on the employment card in ink and returned the card to him as identification. His metallic check or badge was issued and the card lifted by the time checker on his second field check. This method was used to prevent men from walking away with their badges before going to work. All badges had to be shown on pay day before the envelope was handed out. Lost numbers were never used on the pay roll. Unissued and returned badges were kept on numbered pins on check boards; and the boards themselves were designed to close and lock. A discharged man was given a discharge ticket by his foreman and was sent to the division time office. Then he surrendered the ticket and his badge and was given an order on the cashier's office for his money. A man quitting kept his badge until the following pay day; before paying off the division paymaster compared the roll which was to be paid with the current roll, marked the envelopes of all men not shown on the latter and these badges were lifted.

DISTRIBUTION OF MATERIALS—All carload shipments were set by the railroad on sidings at a central point, and the materials of construction were unloaded into storage piles or directly to trucks and wagons and delivered to the construction division as required. The superintendent of distribution directed all labor at the central point and the operation of the trucks and teams themselves, but the division superintendents unloaded materials delivered to them. Materials were distributed generally in accordance with the orders of the division superintendents, telephoned to the delivery office and received by the distribution clerk. Deliveries were checked by one of the engineers of distribution stationed at the delivery office and provided with tabular charts showing the total quantities of each, size or kind of lumber or other materials required by each division with spaces to enter the quantities delivered daily. The division superintendents were provided with similar charts.

In theory the division superintendents were required to telephone to the delivery office each afternoon their requirements for the following day. These orders were arranged upon a delivery sheet by the distribution clerk and checked by the engineer of distribution in time for use in the morning. All cars set in during the night were opened and inspected and the contents noted before starting time, and those containing material urgently needed were so marked for immediate unloading.

Loaded trucks and wagons were driven past the distribution office, reported their loads, were directed to the proper division and were checked out. On their return they were checked back and the trip time recorded. All were numbered with painted tin tags for identification. As soon as a load was sent out it was tallied against the division it was sent to, on the daily delivery sheet. For this purpose the unit was the two-horse-wagon load, as a piece tally was too hard to keep straight. Automobile truck loads were marked with two tallies, or as the capacity of the machine required.

Each day the engineer of distribution entered quantities delivered, as shown by the previous day's delivery sheet, on his material charts. He also kept in touch with the material clerks at the divisions and was then able to distribute correctly material on the siding not called for on the day's delivery sheet. Undelivered quantities were not carried forward to the next day's delivery sheet, but the division superintendent was required to reorder. This put the burden of correct daily orders on the superintendents and left the distribution clerk free to devote himself to filling them.

Since the load tally showed the piece quantities only approximately, and since it was frequently necessary to cut or splice lumber to keep things moving, it was necessary for the divisions to take occasional inventories of material on hand and for the office engineer to check these against the records of material delivered and material erected.

Less-than-carload shipments consigned to a certain division were delivered direct. General supplies were taken to a central storehouse and redistributed. Trucks and teams for hauling within the divisions were requisitioned from the superintendent of distribution and assigned by him, and their time was carried on his pay rolls. Division superintendents were required to sign daily team tickets for these, showing the times of their arrival and departure.

Notices of shipment received by the purchasing agent were turned over to the traffic manager, who was responsible for tracing and placing all shipments.

PAYMENTS—Payments were based upon approved and receipted bills and upon properly certified pay rolls, and were made daily through the Government auditor.

Chart II—Construction of Shipbuilding Plant

On this work everything was performed by the contractor acting as agent for the Government.

GENERAL MANAGER

- Assistants to General Manager—Legal, Executive, Personnel, Contracts
- Chief Engineer—Consulting Engineer
  - Structural engineer
  - Mechanical engineer
  - Engineer of utilities
  - Chief draftsman
- Purchasing Agent
  - Buyers—materials, supplies
  - Superintendent of stores and materials
    - Storekeepers
    - Material checkers
    - Bill clerks
    - Expeditors
- Treasurer
  - Auditor
    - Accountants, voucher clerks, cost records
  - Chief paymaster
    - Pay staff
    - Division paymasters
      - Timekeepers and checkers
      - Pay roll clerks
- Works Manager
  - Office engineer
    - Division materials engineers
      - Estimators
      - Distribution clerks
    - File clerk
    - Blueprint file
    - Draftsmen—construction methods, etc.
  - Traffic manager
    - Expeditors—foreign and connecting lines
    - Yardmaster
    - Master mechanic—locomotives, cars
    - Car-record clerks
  - Superintendent marine transportation
    - Captains, lighters and tugs (not employed on construction work)
    - Foreign and connecting boat lines
  - Superintendent of equipment
    - Purchase orders, leases and records of land equipment
    - Purchase orders, charters and records of floating equipment
  - Chief paymaster (see above)
  - Field engineer
    - Division engineers
    - Chief inspector
    - Estimators of payment quantities
    - Progress records
  - Employment manager
    - Labor scouts
    - Employment record clerks
    - Medical staff
      - Welfare
    - Superintendent of police
    - Fire chief
  - General superintendent of construction
    - Assistants to general superintendent
    - Superintendent of distribution
      - General foreman of unloading
      - Yard foremen
      - General foremen trucks and teams
      - Dispatcher
    - Superintendent of railroads
      - Subcontractors on construction
      - Maintenance foreman
    - Superintendent of roads and drains
      - Foreman of roads
      - Maintenance foreman
      - Foreman of drains
    - Superintendent of water and sewers
      - Subcontractors on construction
      - Maintenance forces
  - Superintendent of light and power
    - Subcontractors on construction
    - Maintenance forces
  - Superintendent of repair shops
  - Superintendent of dredging
  - Division superintendents
    - Division engineers (see above)
    - Subcontractors on construction
  - Superintendent of miscellaneous buildings, etc.

GENERAL—The size and scope of the work made certain general departments necessary, although construction was subdivided into contracts. The general departments were planned to interfere as little as possible with the contractors and to assist and coördinate the contractors' efforts rather than to relieve them of work. This principle applied straight through, not only to purchasing, timekeeping, etc., but to the construction of everything on the contract sections. Thus, the construction departments building railroads, sewers and water systems, roads, miscellaneous buildings, etc., were permitted to do no work on the territory of the subcontractor for a group of shipways, for example, except at his written request. Such a subcontractor was thus responsible for everything on his section, and for the coördination of all construction processes. As a matter of fact, special work such as tracklaying, electric wiring, etc., was usually performed by the general departments at the contractor's request.

DESIGN—All designing done and drawings made by chief engineer's department, tracings recorded and filed by chief engineers' department; blueprints issued to office engineer and recorded and reissued by him to field engineer and construction divisions. Structural drawings listed materials required as far as possible.

FIELD ENGINEERING—The field engineer's duties comprised: (1) Laying out of construction work, furnishing lines and grades; (2) inspection of construction work as to quality; (3) measurement of quantities of work done, preparation of payment estimates with necessary records; (4) progress charts and records. The division engineers in charge of the field parties in the various divisions were under the direct control of the division superintendents as far as the requirements for lines and grades were concerned, and in this particular the field engineer acted as a clearing house, supplying field men where needed. All records and reports were kept in standard form, however, and were turned into the field engineer's office to be worked up.

SCHEDULES.—Master schedules were made up by the general manager in consultation with the chief engineer and the works manager. Detail schedules for ordering material, etc., were made up in accordance with the master schedules by the division superintendents in consultation with the office engineer and the division material engineers. Progress records and charts corresponding to the schedules were made by the division engineers under the direction of the field engineer and were checked and summarized by the office engineer, who also exhibited them in the chart room.

PURCHASES AND STORES—Requisitions and orders were handled in general as described under Chart 1. Requisitions for construction materials were worked up by the division materials engineers and approved by the office engineer. Requisitions for supplies had to be approved by the division superintendent.

EQUIPMENT—The great quantity of plant required made it necessary to employ a superintendent of equipment to look after it. He was authorized to get prices on plant and to buy, sell and rent it, thus relieving the purchasing agent of the function; was required to record the arrival, transfer and release of all plant items, to inspect all equipment and to arrange with the division superintendents or with the superintendent of repair shops to make necessary repairs before release. His functions did not include any physical work upon the plant except painting or stamping identification numbers. Purchase orders for new machinery had to receive the approval of the works manager.

MATERIAL CHECKING—Material checkers and storekeepers reported receipt of material and supplies on proper forms to the superintendent of stores, who recorded and listed receipts against purchase orders. Lists were then transferred to bill clerks and bills were checked against them. Checked bills were passed on to the Government for approval and then to the auditor for vouchering and payment.

CHIEF PAYMASTER—The chief paymaster, although employed and directed by the treasurer, was under the direct control of the works manager in regard to time, divisions, bonuses of pay, etc. In general, he appointed a division paymaster for each subcontract or construction division, whose duty it was to keep time, make up payrolls and supervise paying off in the division, working in harmony with the division superintendent. The chief paymaster coördinated the work of the divisions, standardized methods and made up all pay envelopes and delivered them to the division offices on pay day. The timekeeping system was the same as that described under Chart 1, except that employees were furnished with numbered badges mounted on pins instead of checks and were required to display them at all times.

EMPLOYMENT—The employment manager directed the actual employment of labor as described under Chart 1, and supervised the work of the subcontractors' labor scouts to prevent interference, and in addition controlled industrial relations between labor, the principal contractor and the Government. In view of the fact that this organization, after the construction of the yard was completed, was to be swung into the permanent yard operation, the employment manager was also put in charge of all welfare work and of the fire and police departments.

DISTRIBUTION OF MATERIALS—Distribution of materials involved first the placement of carload shipments on the right sidings, and second the delivery from central storage points of materials like lumber and cement used by all the divisions. Although rehandling of this kind was undesirable, much of it could not be avoided, especially in the early stages of the work, before much track had been laid. The yard foremen, with their labor gangs for unloading and reloading, and all trucks and teams, were directed by the superintendent of distribution. Assignment of teams and deliveries from the yards were handled generally as described under Chart 1, although the yard records showed only material on hand and material delivered, and deliveries were made only on order from the divisions. Trucks and teams were assigned to the division as described under Chart 1.

The problem of proper placement of cars was more difficult than the rehandling of material, and the method used involved a study of the functions of the purchasing and the traffic departments, and of the office engineer, who originated the requisitions for materials. As described previously under "Purchasing and Stores" and "Material Checking," the purchasing department was responsible for pricing, ordering and shipping material, for checking it after it arrived, for checking bills and for all incidental details. This involved comparing quantities received on each order with the quantity ordered, but did not require any record of the distribution of quantities. Notices of shipment received by the purchasing department were turned over to the traffic department to be followed up.

The office engineer was responsible for planning the distribution of materials. He assigned to each division a material engineer whose duty it was to requisition and follow up the delivery of materials for his division. These engineers, although working under the general direction of the office engineer, were directly responsible to the division superintendents as regards ordering material, planning distribution of it and recording deliveries. The divisions' numbers were marked on all requisitions and as far as possible on all purchase orders. Shippers were required to refer to the order number on bills, invoices and notices of shipment.

In order to afford a clearing house for information secured or required by the three departments, a visible card file was kept jointly by them. In the case of carload shipments, which of course made up the greater part of the incoming material, this information came through telegraphic notices of shipment, invoices, reports of expeditors, reports from nearby railroad yards, and finally from the receiving yard check. The number of each car reported in transit, with the date of shipment and contents if known, was entered on a card as soon as the information was received, and the cards were arranged according to the last figures of the numbers. An engineer assigned by the office engineer was required to keep constantly in touch with this file and with the material engineers for the divisions and to note the destination of each car on its card. Cars arriving at the receiving yard without previous notice were opened on arrival, and the contents noted and reported to the distribution office, and they were then listed like the others. The yardmaster's switching list was made up nightly from the card file. The traffic manager's daily report of cars received, unloaded and on hand was also checked against this file.

PAYMENT—Payments were made as described under Chart 1.

upon recent Government contracts, and for the sake of clearness are commented upon as having been actually used. They apply to two distinct forms of contract, and are published here, together with the notes explaining their features, for comparison. Before deciding upon any form of organization, however, the executive should consider the capabilities and idiosyncrasies of the men whom he has available for the higher positions, for an organization built up about these men is likely in practice to work out far better than one theoretically more nearly perfect in which they are fitted into preconceived positions without regard for their personalities.

The charts are arranged in a more compact form than that commonly used. Titles of equivalent rank are placed with their initial letters in the same vertical line, the more important to the left. Thus men in line 4 report to superiors in line 3, men in line 3 to superiors in line 2 and so on. This arrangement, while perhaps not as clear as the customary rectangles and connecting lines, saves space and also makes it possible to express a large organization on a common typewriter.

Temporary Bridge of Old Girders Has Suspended Floor

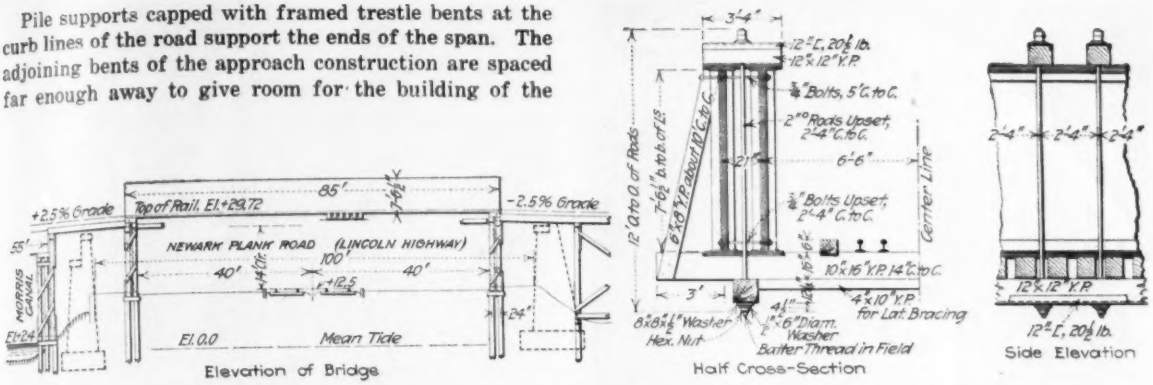
Double Girders Carry Railway Tracks Over Highway On 85-Foot Span—Bolt Suspension of Ties Gives Equal Loading

BY INGENIOUS utilization of available old material the Pennsylvania R.R. has just built an urgently needed highway crossing quickly and at low cost. The solution of the problem involved doubling the girders and suspending the floor from them by long bolts, distributing the load equally between the girders. Timber floor construction was adopted, as best suiting the requirements of the case. The crossing as built is temporary; it is to be replaced eventually by a 100-ft. through-girder span with solid floor, on masonry abutments.

A spur track to the Federal Shipbuilding Co. yard, just west of Jersey City, N. J., was needed, and to reach this from the main track a mile away required crossing the Newark Plank Road (Lincoln Highway), a heavily traveled thoroughfare 100 ft. wide running along the north edge of the shipyard. Among the bridge material which the railroad had on hand were some 85-ft. plate girders, taken out of service because too light for present-day traffic. W. C. Bowles, engineer of construction, planned to use these by placing two side by side and suspending the floor by bolts between the two girders of a pair.

This scheme was carried out, as shown by the sketch herewith. Heavy ties spanning the full floor width are suspended by hanger rods engaging cross-blocks over the top flanges of each pair of girders and a longitudinal timber under the ties. Steel channels distribute the washer pressure produced by the bolt load. The lateral construction of timber diagonals under the floor, bolted to the ties, and the swaybracing of raking timber struts bolted to extensions of the ties and fitted under the top flange of the outside girder are fully shown in the drawing.

Pile supports capped with framed trestle bents at the curb lines of the road support the ends of the span. The adjoining bents of the approach construction are spaced far enough away to give room for the building of the



TWIN GIRDER AND SUSPENDED FLOOR CONSTRUCTION MADE POSSIBLE THE USE OF OLD STEEL FOR BRIDGE

masonry abutments on which the permanent crossing is to rest.

Erection was accomplished without interrupting traffic on either the roadways or the trolley tracks of the highway. Timber bents were set up between the tracks and the roadways, dividing the span into three parts, and timber stringers were laid over these to form a temporary support at the railroad grade level. The girders, brought up on cars on the approach track, were skidded along over this temporary supporting structure with the use of rollers and rope tackle. When in the proper longitudinal location they were turned up from the flat position to the vertical position by a derrick car.

The structure was designed in the office of H. R. Leonard, engineer of bridges and buildings, Pennsylvania R.R., and was erected by the Stillman-Delehanty-Ferris Co., contractor.

Trails Constructed by National Forest Service

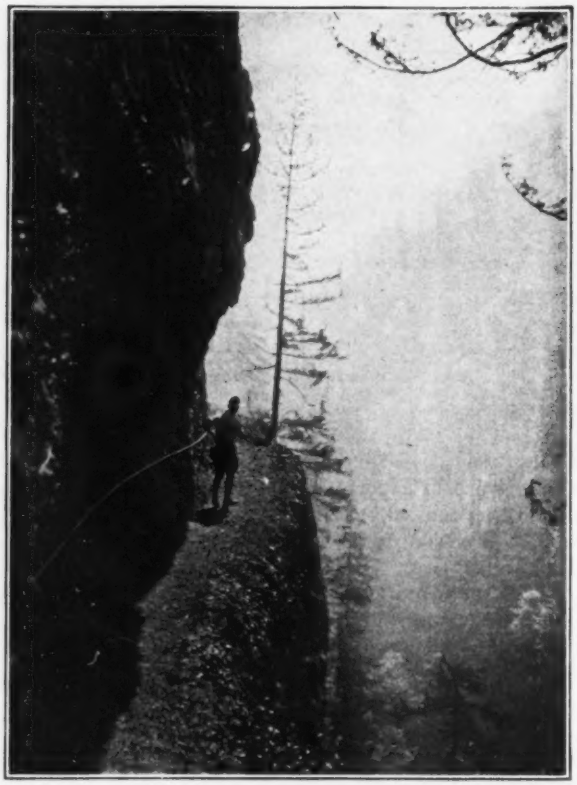
Classification, Forces Used in Construction and Cost of Unique Class of Road Building in Rough Mountains

MOUNTAIN trails, constructed by the United States National Forest Service, while narrow, are often difficult to locate and build. The illustrations show the sort of rock cuts required, many of them in most picturesque locations. One view shows excavation in progress at the Devil's Backbone, Rogue River Trail, in the Siskiyou National Forest. Another depicts the approaches to a tunnel under a fall on the Eagle Creek Trail in Oregon. A third view shows a completed portion of the Eagle Creek Trail, at a point where it was necessary to place a hand rail at the inside.

These trails are divided into three classes. Class A includes main trails, sometimes suitable for wagon roads; class B, secondary trails, connecting main trails and not used for vehicle travel; class C, branch or spur trails. The points of difference between the three classes are given in the table.

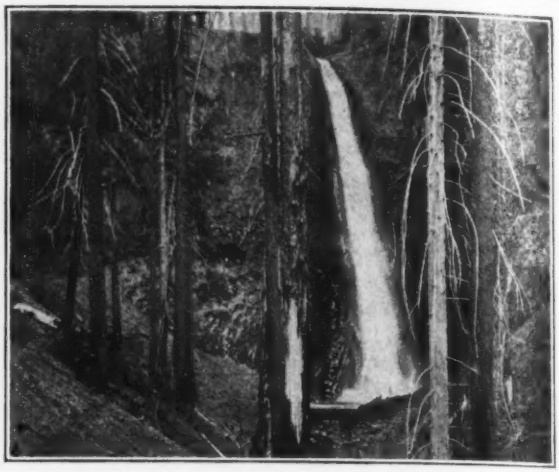
The Forest Service has found that trails can usually be constructed most economically by a 10-man crew, this being about the minimum force which can be managed so that everyone, including the cook, is kept busy. The average 10-man crew frequently includes a foreman, a cook, a packer, two swampers and five graders, or, if the route lies through a region of thick undergrowth, there may be a foreman, a cook, a packer, two brushers, two buckers and four graders. Where much rock work is needed, drillers and powder men are added to the list. By selecting a foreman who can share in or direct any kind of work that may be encountered, the crew often makes very good progress with one or two men less.

ROCK CUT AT DEVIL'S BACKBONE ON SISKIYOU TRAIL



WHERE EAGLE CREEK TRAIL, OREGON, ROUNDS A POINT

On the eastern slope of the Cascade Mountains the undergrowth is light and the slopes are ordinarily smooth or rolling. In this territory trail costs range from $20 to $100 per mile. On the west side of the divide the undergrowth is much heavier, the slopes are steeper, and the rock work is more frequent, so that costs range from $75 to $350 per mile, the average being about $200. This cost includes small bridges. Any bridge estimated to cost more than $100 is considered as a separate project. Trails are occasionally built through territory where rock work is continuous, thus greatly increasing the cost. An example is the recently constructed 28½-mile Rogue River Trail in the Siskiyou National Forest, which included an unusual amount of rock work and averaged about $500 per mile in cost.



TUNNEL CARRIES TRAIL UNDER FALLS

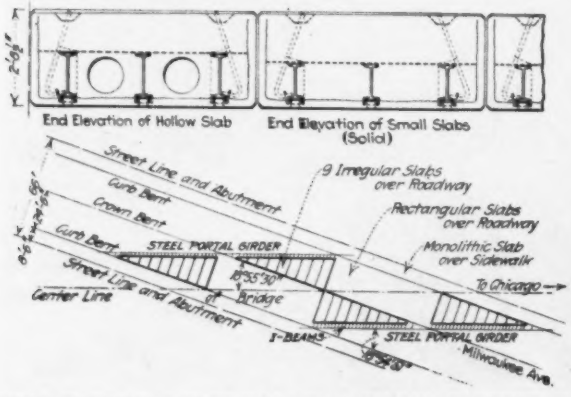
CLASSIFICATION OF FOREST SERVICE TRAILS

	Class A	Class B	Class C
Tread (net)	15 in. to 48 in. as necessary	12 to 48 in.	12 in.
Grade	0 to 15% 10% standard	0 to 20%	Any grade a horse can get over
Clearing (net)	6 to 10 ft.	6 to 8 ft.	4 to 6 ft.
Switchbacks	To be avoided	Allowable Legs long	Whenever desirable

Skew Subway Bridges Require Special Design

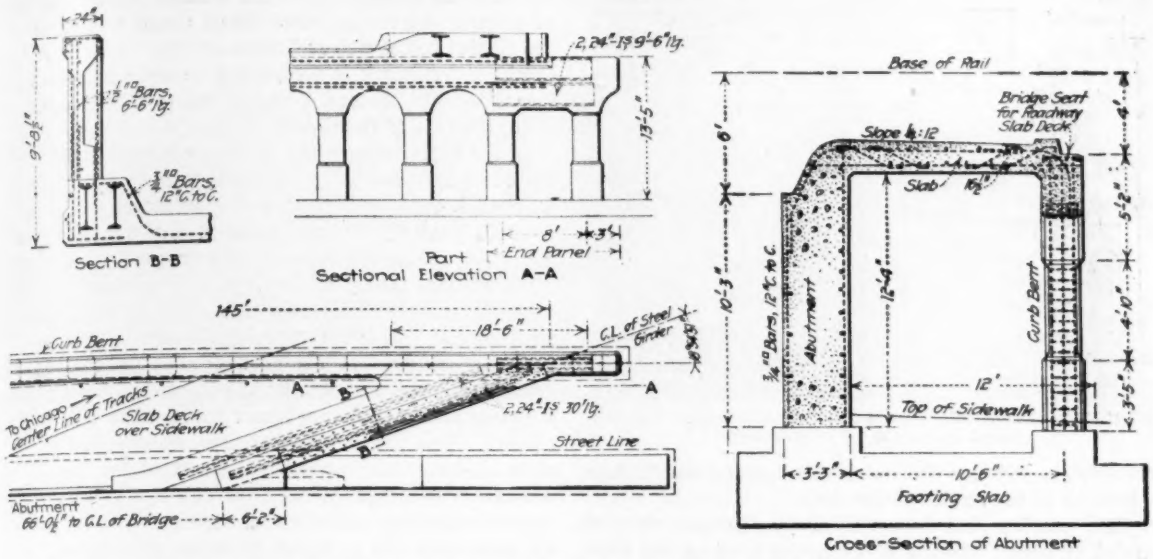
Chicago & North Western Uses Monolithic Sidewalk Spans With Roadway Having Precast Slabs and Steel Portal Girders

REINFORCED-CONCRETE subway bridges recently constructed for track-elevation work in Chicago are of unusual design in having each sidewalk span formed as a monolithic structure combining the abutment, sidewalk bent and deck slab. In effect, it includes the footing or foundation slab also, for though this is built in advance it is bonded to the abutment and bent. As a rule, the footings are constructed before the tracks are elevated, and the other three elements are built as a unit after the tracks have been raised. This arrangement permits the footings to be constructed at any convenient time, independent of the elevation of the tracks. This design is used by the Chicago & North Western Ry. on the Mayfair (Chicago) track elevation of its Wisconsin division.



SKEW SUBWAY BRIDGE HAS STEEL PORTAL GIRDERS TO SUPPORT PRECAST SLABS OF ROADWAY SPANS

One advantage of this design is economy of material in the abutment, for this would have to be very much thicker at the footing if it were built independently instead of being combined with the deck slab and bent to form a structure which is stable against earth pressure. Formwork and the placing of concrete are said to be simplified by the monolithic construction. When deck slabs are built separately, the tops of the abutments and curb bents must be formed with care and precision to provide proper seating for the slabs. The latter also must be made with care to insure this seating. Furthermore, it is pointed out that the elimination of joints removes the need of providing special arrangements for carrying the waterproofing across the joints. In the monolithic structure there is no liability of rupture of

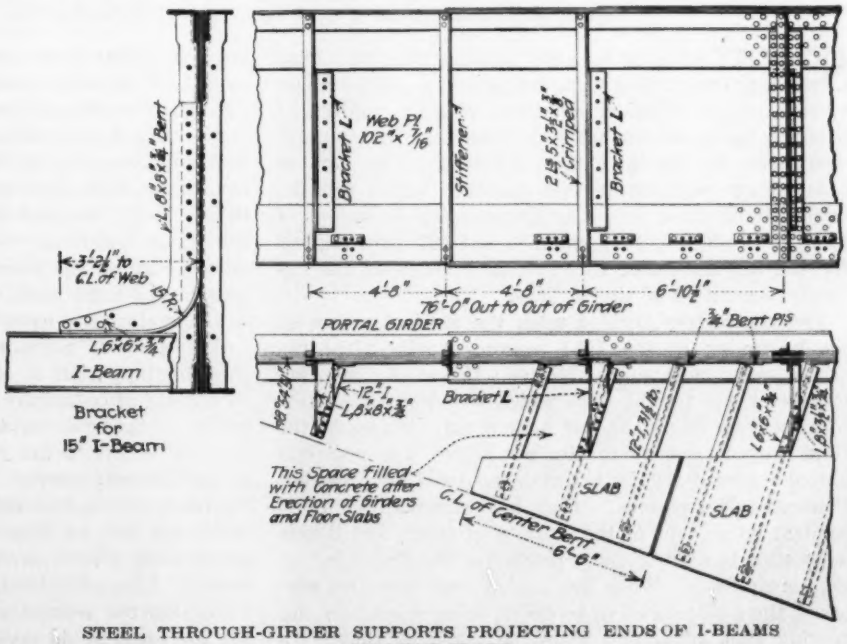


SIDEWALK SECTION OF SUBWAY BRIDGE IS BUILT AS A MONOLITHIC STRUCTURE, ELIMINATING JOINTS

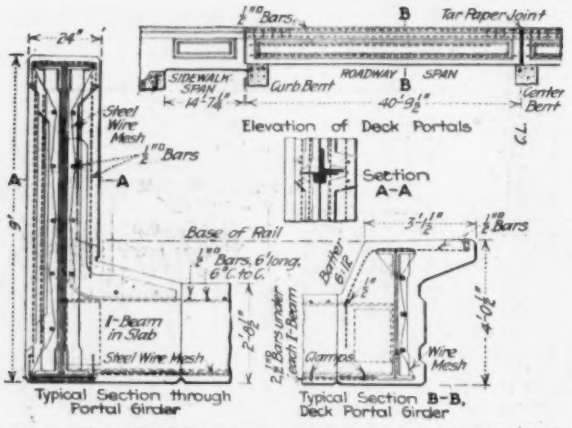
the waterproofing membrane by displacement of parts or local movement under deflection. Foundation piles were not used, except in one case where a sewer was adjacent to the footing slab.

The sidewalk bents have rectangular columns spaced 8 ft. on centers and carrying a heavy cap girder. Arched openings are formed between the columns. The last opening at each end of the bent is spanned by I-beams supported over the columns and embedded in the girder. This construction is necessitated by the fact that, owing to the skew of the crossings, the end bearings of the steel roadway girders and the I-beams in the deck slab of the sidewalk span are brought directly over these end openings. In most cases the supporting I-beams are sufficiently shallow to allow the retention of the arch form of the opening. At Milwaukee Ave., however, the sharp angle of skew makes the bridge girders very long, with heavy end reactions that require deep connecting girders between the two end columns of the bent. In this case a flat-top opening between these columns is made necessary. The clear width of sidewalk, measured on the square, is 8 ft. The deck slab of the subway is 14 in. thick, increased to about 3 ft. at the ends, where it is formed into a girder consisting of a pair of 24-in. I-beams incased in concrete. This girder carries a projecting concrete portal slab forming a runway, which is built after the girder and bonded to it by vertical reinforcing rods. This girder has a paneled face and conforms to the appearance of the concrete-cased steel portal girders of the roadway span. All of the concrete used is a 1:2:4 mix, using crushed stone as the coarse aggregate. The formwork is of wood.

Portable or precast deck slabs of I-beams incased in concrete are used for the roadway spans of 24½ ft. In these the I-beams are designed to carry all the load, the concrete serving as bracing, solid floor and protection for the steel. Cylindrical spaces are formed in the concrete to reduce the weight of the slab. These slabs and the floor construction are the same as used by this railway for its track elevation at Milwaukee, described in *Engineering News-Record* of Mar. 14, p. 511. At Chicago, however, all the crossings are on a skew of such acute angle as to require special construction to



STEEL THROUGH-GIRDER SUPPORTS PROJECTING ENDS OF I-BEAMS OF DECK SLABS



THROUGH AND DECK PORTAL GIRDERS OF SKEW BRIDGE ARE INCASED IN CONCRETE

provide support for the outer sides of the small slabs which fill in the angles of the deck.

This problem has been solved by the use of steel portal girders. These are below the level of the base of the rail, except at Milwaukee Ave., where the extreme skew requires very long girders. In this case, they are through-plate girders 8½ ft. deep with side reinforcing plates and two angles for each chord. The I-beams of the deck slabs are of such length as to rest upon the bottom chords of the portal girders, but the concrete of the slab is made shorter, so that the beams project about 3 ft., and in erection an open space is thus left between the slab deck and the girder. This is done to allow riveting the connections at the ends of the beams, and of placing the curved brackets or gusset angles which are riveted to the web stiffeners and the I-beams. After erection, formwork is placed and concrete is poured to incase the girders and I-beams and to fill the opening along the side of the slab deck.

In the casing concrete ¾-in. stone is used. This concrete is reinforced by vertical and horizontal rods, with wire mesh over the chords, and is anchored to the steel by rods passing through holes in the web stiffeners. After the forms are removed the exposed paneled surfaces of the casing of the roadway girders and the concrete girders of the sidewalk spans are finished by rubbing down with carborundum blocks.

These bridges are designed for Cooper's E55 live load. Dead load is taken as 550 lb. per square foot for the slabs and 3500 lb. per linear foot for the steel portal girders. The use of these girders, necessitated by the skew construction, increases the cost of the design as compared with that of the Milwaukee subways, which are practically on right-angle crossings and have only the deck slabs. It is stated, however, that the cost will not exceed that of the earlier type of subway bridge used by this road, having the spans formed by a self-supporting steel-trough deck carried by steel bents.

The track elevation in these cases was carried on entirely by the railway company's forces, with J. S. Pole as engineer in charge of the work both at Chicago and Milwaukee. The design and construction were directed by W. H. Finley, chief engineer of the Chicago & North Western Ry., and O. F. Dalstrom, bridge engineer.

Labor Shortage Made Good by Station Contract System

Winnipeg Aqueduct Workers Speed Completion of Huge Job at Contract Prices Which Net Thirty to Forty Per Cent Increase in Wages

By F. P. Kemon
Superintendent, Camps 1 and 5, Winnipeg Aqueduct Construction Company, Ltd.

SCARCITY of labor brought about a trial of station work, or contracting different jobs to a small number of men, on the Winnipeg aqueduct, with the result that in some instances the work is being carried on with men fewer by one-third than formerly. The type of construction required on this aqueduct, which was described by William Smaill in *Engineering News-Record* of Apr. 19 and 26, 1917, pp. 121 and 180, proved ideal for the application of this system because of the extensive repetition of similar jobs.

The contractors decided upon the station system at the beginning of the 1917 season, shortly after the articles mentioned were published. It was the intention to make prices for the work which would allow the men to earn from 10 to 15c. per hour extra. Wages at the time ranged from 30 to 40c. per hour. The men employed included Belgians, Russians, Austrians, Swedes, Poles and Norwegians. They had become very independent on account of the scarcity of labor, and it was impossible to maintain any discipline while working on the hourly basis. When the station work was first proposed, the men refused to accept it, being suspicious and fearing that advantage would be taken of them. In some instances large numbers left the work, as many as 50 to 75 deserting some camps at one time. The most difficult to handle and the last to take hold of the station work were the Austrians. The Belgians accepted it first and proved to be the best workers under this arrangement, with the Swedes second and the Norwegians third. After the men had worked a short time under the system and found that it was possible to make more money than on the hourly basis, there was no further trouble in letting work, and the plan proved successful in conserving man-power.

A schedule of prices to be paid was made up by the chief engineer, but it could not be strictly adhered to on account of constantly changing local conditions. The letting of the work and the prices to be paid had, therefore, to be left to the judgment of the men in charge at the different camps. No record or schedule of working hours was maintained, as in most instances the men would get out an hour or two before breakfast, and would always work several hours in the evening after supper. They also developed in a short time a keen insight into the cost of doing the work, and in dickering for work would try all kinds of subterfuges to in-

WORKMEN MOVED A WHOLE PORTABLE CAMP ON CONTRACT FOR FROM $500 TO $700

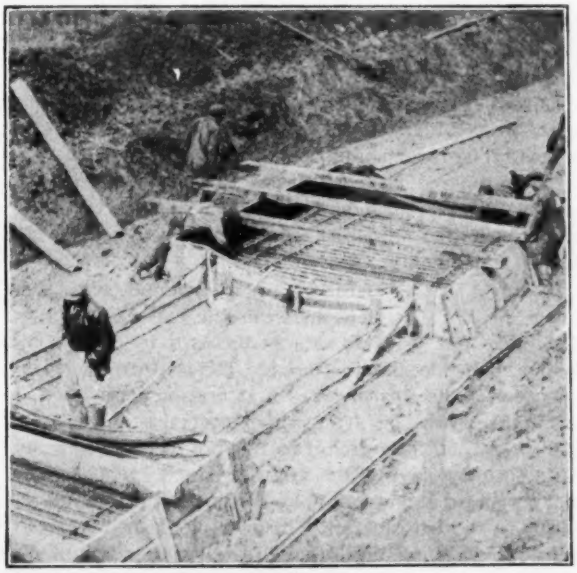
crease the price demanded. Most of them were absolutely conscienceless as to keeping a contract which did not prove as profitable as they had anticipated, and showed no hesitation in throwing up jobs and going to other camps to look for work. Considerable care and diplomacy were required of the men in charge in order to keep the cost of the work down and still continue the system.

When a contract was let and the work started, the resident engineer for the contractor would record the station and report the progress of the work. These reports furnished the basis of payment. Working in gangs, with one of the party acting as leader, the men often earned from $8 to $12 per day. The leader would do the bidding for the gang, and they would be governed by him. Often one gang would take three or four different contracts in order to work continuously throughout the day, and when it was not possible to do this they would work on the hourly basis for several hours while waiting for additional station work to become ready.

As was related in the articles referred to, the excavation to within 6 in. of grade was done by draglines, most of the aqueduct being cut-and-cover section in very flat country. The excavated material was placed alongside the tracks to form an embankment, upon which was built a 3-ft.-gage railroad used in placing concrete. A templet was employed to keep the center line of this embankment parallel to the center line of the aqueduct, so that the traveling concrete chutes would work properly when moved along the line. The grading of the top of this embankment was the first work let on the contract basis, at prices ranging from 3 to 6c. per linear foot, according to the amount and nature of the material to be handled. One or two men usually performed this work.

A wood box drain of 8 x 10-in. section was next placed in the center of the aqueduct trench, 2 ft. below the bottom of the invert grade, with a 2-in. layer of screened gravel all around it. These drains were built of 2 x 6 x 16-in. plank with tops and bottoms of 1-in. material. They were nailed together by contract for 1½c. per linear foot. The work of excavating and setting these drains, including placing the gravel, was let for 5 to 10c. per linear foot, according to the nature of the materials excavated, which varied from creek sand and muskeg to solid rock. Four to eight men usually worked at these contracts. Cross drains at intervals of 500 ft. were also required, which carried water to sumps outside the line of the aqueduct, from which it could be disposed of by gasoline-driven pumps. The gravel used in placing these drains was delivered along the trench, and was not included in the contract.

Following the placing of the box drain, pioneer invert forms 13 x 15 ft. by 6 to 24 in. high were next set. This work, including oiling the forms and placing a 4-in.



FORMS WERE SET AND OILED FOR $1.75 TO $2.50 EACH

copper strip at each end for a waterproofing joint, was let for $1.75 to $2.50 a section, the work being done by two or three men. After the concrete was placed, these forms were stripped and moved ahead for 75c. per set by two men. Intermediate invert forms were set up, dismantled and carried ahead, for 75c. per section, usually by three men.

The excavation for these forms was performed for $1.75 to $5 per section by three to four men. The concrete in the invert section was screeded by three men for 75 to 90c. per section, and the trough finished for

INSIDE AND OUTSIDE FORMS WERE MOVED AND SET BY EIGHT TO TWELVE MEN FOR $20 to $27.50 PER ARCH

60 to 90c. per section, including the placing of a ¾ x 1 in. by 15-ft. cedar strip in the center of the haunch and roughing up the top of the haunch with a wire brush after the concrete had set.

In soft ground sections the aqueduct was carried on timber piles 20 to 30 ft. long, eight being used to a section of invert. These piles were driven by a contractor who furnished his own plant. The work of cutting them off and bracing them was done on the station system, for $3.25 per invert section, by four men. This consisted of cutting off the piles and cutting and placing cross braces, drifted to them with ⅞ x 18-in. square spikes. The inverts and the sections supported on piles were reinforced with 72 pieces of ¾-in. twisted bars, which were placed and wired at $3.25 per section, this work including also the cleaning and oiling of the forms and finishing the excavation.

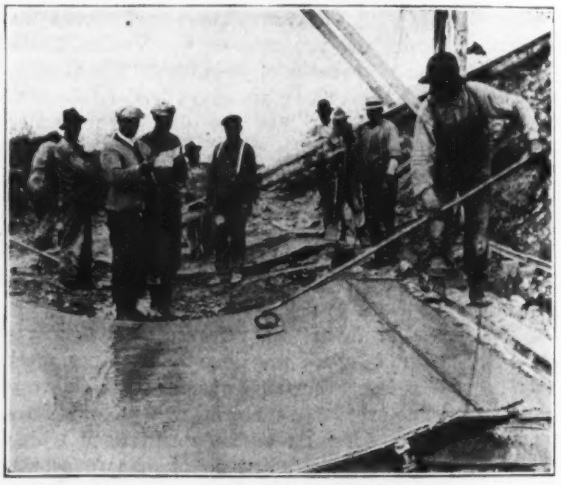
The first section of the aqueduct was made with steel forms in 45-ft. sections between the expansion joints, 6 outside and 4 inside sets being used in each camp. Both the inside and the outside forms were moved on travelers. The former were first erected in the trench on an hourly basis, after which contracts were let at $20 to $27.50 per arch for moving and setting up. This included laying the traveler tracks, dismantling, moving ahead and erecting, and oiling and preparing the forms to receive concrete. From 8 to 12 men were required on this job, according to the varying size of the aqueduct. These gangs would set up three to four arch forms per day. They were furnished with a gasoline dinkey free of charge, to pull the sections, one of the gang operating the dinkey.

Central concrete mixing plants equipped with 18-cu.ft. mixers and bins of 500-yd. capacity were used on the work, being located about half a mile apart. Aggregate was delivered in air-dump cars, the sand and gravel being already proportioned. Cement was delivered in sacks, and was unloaded and stored in the cement houses for 1c. per sack. A 3-ft. gage track at each plant carried 1½-yd. Z-body dump cars, which delivered materials from the bins to the mixer. These cars were loaded by contract at 30c. per yard. As soon as the work was put on this basis the men demanded larger shovels, and from 6 to 8 instead of from 8 to 10 kept the mixers going. One man fed the mixer with cement at 1c. per sack, and did up his own empty sacks in bundles of 50. Previously this work always required two men.

The 3-ft. gage track for hauling concrete to the forms was first laid on the hourly basis in sections 20 ft. long, made up of 20-lb. rail and wood ties, seven to the section. Once laid, it was taken up and moved ahead on the contract, for $1.25 per section. Coal for the draglines and mixers was unloaded for $6 per car.

Foundation fill of gravel was used in soft-ground sections, usually being placed under water in the trench. This material was delivered in air-dump cars to the right-of-way where it was to be used, loaded into wheelbarrows and dumped into the trench from runways. This work was let at 30 to 40c. per cubic yard. In some sections which were so soft that the bank had to be kept an extra distance away from the excavation timber trestles were required for these wheelbarrow runways, which were built at 25 to 45c. per foot. This included cutting from the neighboring brush the timber with which the trestles were built.

That portion of the backfill which had to be placed by hand was contracted at 7½c. per linear foot for each side of the trench. After this fill was placed in 12-in.



SIXTY TO NINETY CENTS PER FORM WAS PAID FOR THIS JOB

layers of sand the draglines completed the backfilling, the top and slopes being then dressed to templet by hand at 4c. per linear foot. The feeding, however, was done on the hourly basis.

Each camp consisted of 12 to 15 frame buildings, made up in sections bolted together, so that they could be taken down and reërected at the next site, as described in *Engineering News-Record* of June 7, 1917, p. 511. Each provided accommodations for 100 to 500 men, $5 per week being charged for board. These camps were taken down and moved complete from one site to another at a contract price of $500 to $700.

The work is being completed by the Winnipeg Aqueduct Construction Co., Ltd., for which William Smaill is general superintendent and W. G. Davies is chief engineer. The writer is in direct charge of camps 1 and 5.

Turnout in High Velocity Canal Gives Good Service

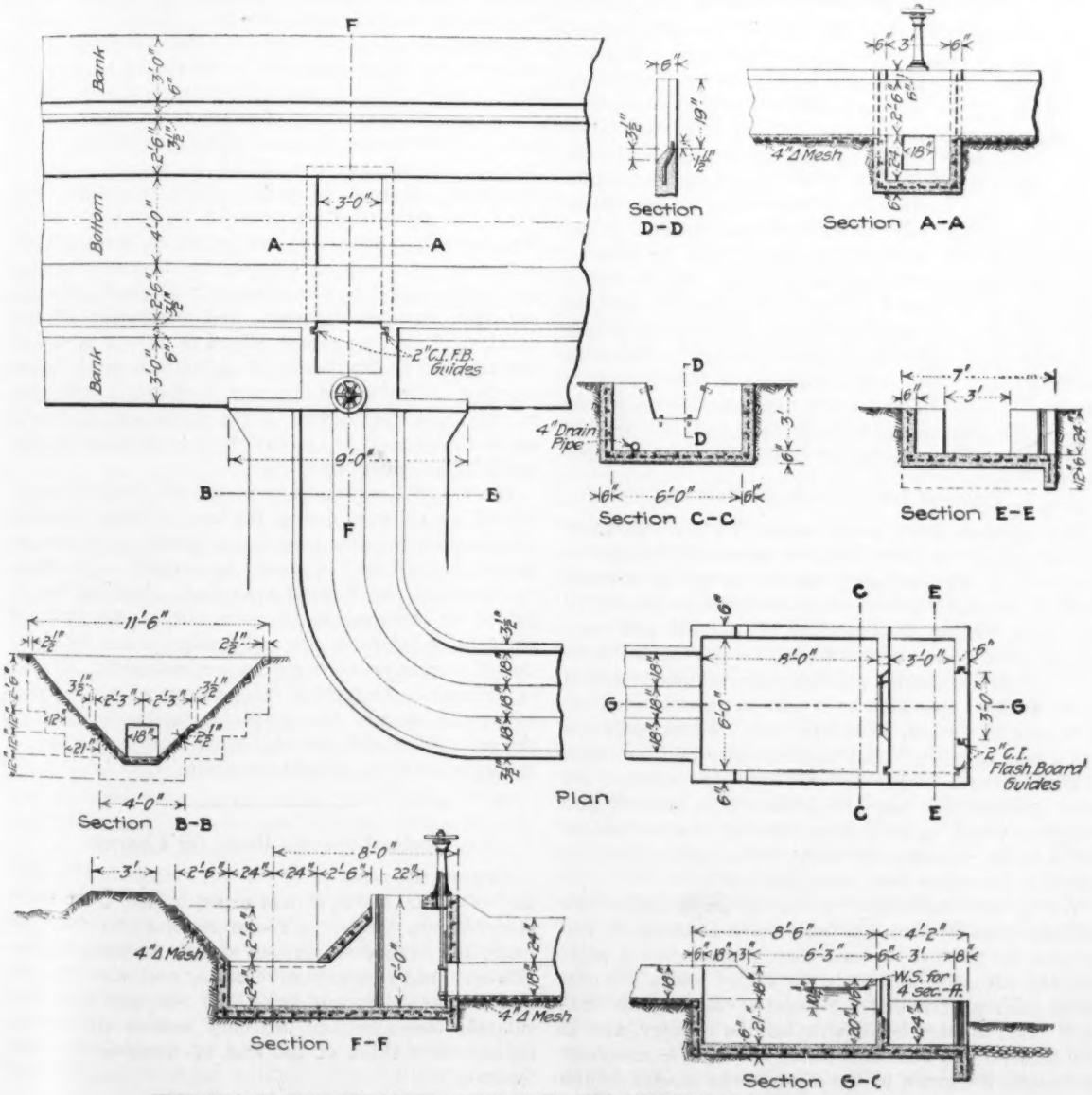
Under Drop in Irrigation Canal Bottom Diverts Water to Branch Without Affecting Capacity of Lateral

By J. L. Lytel

Project Manager, United States Reclamation Service, Provo, Utah

DIVERSION of water under high velocity from laterals to sublaterals is accomplished by under drops on the Strawberry Valley Irrigation Project of the United States Reclamation Service, in Utah. The greater part of the main canals and about 65 miles of laterals and sublaterals are lined with concrete. Many of these laterals are built on comparatively steep slopes and in some of them the velocity of the water exceeds 30 ft. per second. On one of the larger laterals, which has a capacity of 150 sec.-ft., and which was designed and built mainly as a wasteway for the entire high-line canal system, it is necessary to divert water for irrigation purposes at a number of points where the velocity varies from 15 to 30 ft. per second. This must be done without in any way affecting the flow or carrying capacity of the lateral at the point of diversion, as, because the lateral is used for a spillway for taking care of all the excess water that may from time to time be thrown off by the system, the amount of water carried in it is likely to vary considerably, and it may be called on to carry almost its full capacity on short notice. This is particularly true in case of a break on some large lateral of the system or a heavy rainfall.

In order to divert water without interfering with the flow or carrying capacity of the lateral, the special type of reinforced-concrete turnout shown by the accompanying details was designed. The design provides for the water to be taken out of the channel through a rectangular opening in the bottom of the canal, the concrete-lined sides of the canal section not being



TURNOUT IN HIGH VELOCITY CANAL DOES NOT LESSEN CAPACITY OF LATERAL

changed at the turnout. This allows the rapidly moving water to continue on its way without interference, and the lateral will carry its full capacity past the turnout without splashing or unusual commotion. The amount of water taken out at these turnouts varies from 6 to 12 sec.-ft. depending upon the area that is being served from that particular turnout. Turnouts built in accordance with this design have been in operation for several irrigation seasons and have given very satisfactory service under any stage of flow in the lateral.

Railway Corporate Interests Should Be Conserved

Credit Must Be Sustained, and Return of Properties Unimpaired to Owners After the War Is a Duty Under the Law

BY A FORMER GENERAL MANAGER

OPERATION of the railways by the Government brings up prominently the question of the conservation of the corporate interests, not only on behalf of the owners of the railways, but in the public interests as well. The matter of transportation enters so vitally into every avenue of modern life that any disturbance of the conditions affecting it must react upon the public welfare. That anything and everything which affects a war emergency must be done in that interest is unquestionable, but, on the other hand, is it not wise to consider prudently whether the necessity actually exists before action is taken to disturb a situation which does not present a war emergency? The readjustment which will take place after the war will require a return as nearly as possible to normal conditions, therefore is it not wise conservation to distinguish between the essential and the nonessential in adopting the various lines of policy affecting our important transportation interests?

REASONS FOR FEDERAL OPERATION

The railways were placed under Federal operation during the war in order that the maximum transportation, first for war purposes, then for the public interest, could be secured. The corporations were prohibited by law from making combinations of parallel and competing lines, from pooling traffic, from reducing nonessential services, which practices were all made possible under Federal operation as a war-emergency measure. It is safe to assume, therefore, that Federal operation was a war necessity. But this necessity only extended to such changes in pre-war conditions as affected the main purpose. It was not necessary to disturb any condition which in no manner affected the war necessity, and any unnecessary changes must defeat the very purposes for which they were intended.

The railways have asserted that the public policy and attitude toward them for years have rendered it impossible for them to increase their transportation capacity and efficiency, and to do the things which are now being accomplished under Federal operation. Be that as it may, a condition confronted the country, and it was necessary to take such action as would bring about the results demanded by the emergencies created by the war. There was no time to correct the past mistaken policy directed against the roads, if such existed, and the only alternative was to take prompt and decisive action.

We cannot afford, however, to disregard the interests that are involved in the operation under the Government, and their safeguarding is an important question which must receive attention. We are fighting "ruthlessness" and should bear in mind that anything done that adversely affects the corporate interests of the railways which is not a war emergency measure can be classed as an unnecessary disturbance of conditions without any benefit to the public or the war policy. Many things must be done under pressure and the stress of the moment, and some mistakes are necessarily unavoidable, but extreme care and caution should be exercised to conserve in every possible manner the interests vitally affecting the Government and the people as a whole.

The conservation of the corporate interests of the railways calls for the safeguarding of their financial, commercial and physical elements. First, we cannot afford to take any action that will affect the credit of the railways, and must therefore be careful to be just and fair in giving them proper compensation for the use of their valuable properties. Failure to do this must react upon our whole financial policy and destroy confidence in an industry upon which the people are vitally dependent. Second, we cannot afford to disturb needlessly the established commercial customs which are dependent upon rates and service which have been the outgrowth of years of adjustments and development, and which cannot be disturbed without vitally affecting the vast business interests and prosperity of this country. Third, we cannot afford to make a misuse of our railways to the detriment of their physical characteristics. The Federal operation is simply a temporary tenancy, and carries with it the obligations of careful use and return of the railways to the owners in as good condition as when taken over.

The act of Congress authorizing the Federal operation of the railways during the war is ample to protect and conserve fully the corporate interests in the manner above specified, and it should be carried out by those in charge of the Federal operation. Nothing can be gained by endeavoring to carry out a plan that will affect those interests adversely unless it can be shown that it is an endeavor to meet a war emergency. A policy of fairness in conserving the interests of our railways will partly answer the complaint by the railways of the past policy and attitude, which they assert are responsible for their present condition.

Meter Capacity Basis for Charge

Because the capacity of an 8-in. meter is 278 times that of a ¾-in. meter, it was urged by the Terre Haute Water-Works Co., in a recent hearing for increased rates, the minimum charges should be proportionate. "Unless proper minimum charges are made for the larger meters," it was held, "the few who enjoy this valuable emergency or auxiliary service will not be paying their share of the cost of water-works maintenance."

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Hydraulic Interpretation of Indefinite Water-Power Grants

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

WATER RIGHTS' DETERMINATION FROM AN ENGINEERING STANDPOINT—By Jay M. Whitman, M.A., M.E., C.E., Consulting Engineer; Formerly U. S. Naval Engineer; Later Professor of Engineering, University of Arkansas. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 204. $2.50.

Essentially a highly specialized book for hydraulic engineers, this work is intended also for the owners of water grants and for their legal representatives. It relates exclusively to questions of riparian water right interpretation under conditions existing in the Eastern states, especially in the older mill communities. It is intended to assist anyone interested in determining the meaning of an indefinite water grant by furnishing precedents and data for converting such grants into terms of horsepower (when the head or fall is given) or into terms of volume of water in cubic feet per second under a given head.

By an indefinite water grant is meant a grant of water sufficient for a specific purpose, but not stated directly in terms of volume of power. It was common in the early days of water-power development in the East for the owner of a water power to sell or lease water rights adjoining a dam or canal, conveying therewith the right to the use of sufficient water for a specific purpose, as for example, "Water for four runs of mill stones, for a muley saw mill, for a cotton mill of 2000 spindles, for a carding mill, a fulling mill, or for a trip hammer and force." These are examples of indefinite water grants in the sense of the term used in this book. The majority of such indefinite grants were made fifty to one hundred or more years ago. They have often passed through many conveyances from one owner to another, with language unchanged down to the present day. Often every vestige of the original mill is gone. Not infrequently the power was never utilized for the purpose specified in the indenture.

The advent of hydro-electric power development, modern high-capacity turbines, and the tendency toward centralization of water-power stations, gave rise to a new wave of water-right litigation. There is hardly a water-power dam in northern New York where such ancient water grants exist that has not had its "day in court" for the power owners in the past decade. Sometimes these questions have been litigated over and over again at the same dam at intervals of ten or twenty years.

Experience shows that the best interpretation of a water grant may, in general, be made by a hydraulic engineer who has become competent through training, travel, observation, experience and research to view the problems both in the light of local and general experience and practice. Such an engineer may be an invaluable adviser to a court or to his clients in the interpretation of water grants. The author of this book has had a long experience in this class of expert service, and the engineering and legal professions are indebted to him for making many of the results of his experience and research generally available, especially as it seems to be the only book on the subject which has been published.

Books which record the personal researches and experiences of the authors are best calculated to contribute to the fund of permanent knowledge. It is rare that such a record of personal experience covers the whole story. This book relates to disputed questions and, like most books of its class, it should be read with discretion.

The volume opens with a discussion of questions relating to the amount of power required to propel a run of mill stones for grinding wheat. The data given show a considerable range. The author has neglected to state in many instances important facts which would affect the results in connection with the different examples given.

Many of the authorities cited are millwrights who had rules as to the horsepower of water wheels to be installed per run of stones, and the power given is figured from the water-wheel capacity. As a matter of fact, this manner of calculation is almost certain to lead to an excessive estimate of the amount of power required unless the water-wheel gate opening is taken into account, which does not appear to be the case here. Good millwrights installed water wheels not only sufficient to do the grinding under ordinary conditions, but often much larger. Usually there was one water wheel to each run of stones where turbines were used. Stock pattern turbines were made in various sizes, and the nearest size larger than was actually required would be installed. Then again, a wheel was put in large enough to furnish the required power with hard grinding and under the most unfavorable conditions as to character of grain, weather and sharpness of the mill stones, and also sufficient for operation in the spring with reduced head due to backwater. Under ordinary conditions a water wheel adequate to meet these requirements would only operate at part gate or part capacity.

A few examples are cited from Leffel's wheel book as to the power consumed in grist mills. These examples apparently relate to cases where the power used was relatively large. The old Leffel wheel books contained scores of examples of power requirements in grist mills where head, gate opening and all needful data were given. These old books are very scarce, and the preservation of these valuable data in tabular form in the present volume would have been well worth while.

In discussing the power required for a run of mill stones as fixed by certain court decrees the author mentions "the practical interpretation of a grant," but does not clearly define what this means. It appears from the context that the author may have construed this legal

phrase as defining the use made of the grant at the time of the interpretation instead of the use at the time the grant was made, as should be the case where prescription is not involved. There are certain other principles of law which an engineer attempting to interpret a water grant should understand but of which no mention is made.

The power required for grinding grain and for driving auxiliary machinery has increased somewhat progressively from the earliest days down to the introduction of the roller process of flour milling. A knowledge of the history of the development of flour milling is a necessary requisite for the interpretation of early water grants in terms of runs of stones. This phase of the subject has been only slightly touched upon and many important features are omitted.

Many of the data on the general subject of water required for a run of mill stones are derived from Oswego valley conditions as they existed in Civil War times and subsequent years. Some of the data for this locality appear questionable, being derived in part from local histories. The practice cited is not necessarily representative of other years or of other localities. Special conditions existed which must be taken into account in applying these data, and in general the story of flour milling in the Oswego valley, the attendant conditions and the circumstances under which various court decrees were made are not set forth in sufficient detail to form a basis for fair judgment. It would appear that the author, having been associated with these matters in the Oswego valley in connection with litigation, has not had available to him all of the pertinent data and has, therefore, failed to tell the whole story. For example, some stress is laid upon the Varick canal decree, which fixed an exceptionally high value of the amount of power required per run of mill stones. There is at least some evidence that this decree was the result of an agreement and was not a well fought issue. Two bitterly contested cases on the opposite side of the river at Oswego, each of which terminated in a supreme court decree fixing the amount of water per run of mill stones at one-half as on the Varick canal, are not mentioned.

.On p. 29 a table is given of some of the leases of the runs of stone by the Oswego Canal Co. Some of these leases were dated as early as 1826, yet the author has calculated the equivalent horsepower as that obtainable with a good modern turbine. One-half the leases cited antedate the author's own stated time of the introduction of turbines of any kind, and nearly all of them antedate the use of turbines giving the 80% efficiency which is the basis of the table. Furthermore, there are constructive features affecting the interpretation of these leases which are altogether omitted, and which if taken into consideration may nullify the author's conclusions in regard to them. Very likely the author was not familiar with Judson's tests in the early forties in one of the large Oswego mills, as no mention is made of them.

On pp. 33 and 34 the author seems to question the ability of the late Charles Rhodes, and by inference attempts to impeach his character. Rhodes was well and favorably known in the latter half of the nineteenth century in the milling region of central and northern New York. His ability could hardly be questioned by one who had seen the details of the turbine tests which he carried out and which, it is hoped, may at some time be published. These tests were made in a well-constructed flume using a Francis weir and a good friction dynamometer, almost exactly as such tests are conducted at Holyoke. He was agent for the Oswego Canal Co., the owners of power on the opposite side of the river from the Varick canal. There appears to be no foundation for the author's statement that "he was influential if not controlling in determining the meaning of a run of stone on the Varick canal in 1875 to be water enough to give 37.75 horsepower." If he had any influence it was quite certainly opposed to so large a figure.

Summarizing the whole discussion by the author on the question of water grants in terms of runs of stone, it may be said that the book contains a large amount of valuable data on this subject. Sufficient details are not given and sufficient stress is not generally laid on the importance of the date of the grant as affecting the amount of power required. This chapter does not tell the whole story, and it is certain that an equal number of good additional authorities could be brought forward from the same locality. The results would probably be an agreement with the data cited by the author in many cases, but with a tendency toward considerably lower figures, especially for New York State outside the Oswego valley.

No data are given for Rochester, which was a great milling center contemporaneous with Oswego.

The discussion of runs of stone is followed by briefer treatment of other forms of water grants, including cornmeal and feed mills, corn crushers, distilleries, starch mills, oatmeal mills, pearl barley mills, saw and shingle mills, tanneries and various iron-working industries. The data on these subjects are presented in a less argumentative form than in the case of flour mills and are, relative to the amount of data available, much more nearly complete than in the case of flour mills. In fact, data on some of these subjects are extremely meager, and the author has done well to bring forward those here presented.

Next follows a discussion of the power requirements in cotton and woolen mills. Here the author gives the results of numerous original tests hitherto unpublished, which form a valuable supplement to the extensive data of similar tests contained in Webber's "Manual of Power."

Part 2 relates to the interpretation of grants made in terms of the right to use the flow of a stream of specific size, or the flow through a specific aperture or through a specific water wheel. There is a discussion of the water requirements and efficiencies of various primitive forms of water wheels, including tub, flutter, wooden scroll case central discharge wheels, undershot, overshot and breast wheels. Sparse as they are, the data are well presented.

Next follows a brief outline of the development and history of turbines, with a summary of the Fairmount water-works tests of 1859-60, the centennial tests of 1876 and of tests at Holyoke, mainly by James Emerson, prior to 1880. The volume closes with a bibliography and a good index.

This book is to be considered as a contribution to the subject and not as a complete or extensive treatise. Every water-grant problem requires specific research, and anyone interested in such a problem will find the book a useful starting point for such investigation.

Sewage-Works Investigation and Advice

SEWAGE DISPOSAL IN KANSAS: A Discussion of Practice in Certain Municipalities, Together with Instructions to Plant Operators—By F. M. Veatch, H. P. Evans, and L. E. Jackson, with the Collaboration of the Division of Water and Sewage, Kansas State Board of Health. C. A. Haskins, Engineer, C. C. Young, Director of Laboratory. Division of State Chemical Research, Engineering Bulletin No. 9; Lawrence, Kans.: University of Kansas. Paper; 6 x 9 in.; pp. 166; illustrated.

Designed to show what Kansas sewage-works are accomplishing and to serve as a handbook for plant operators in that state, this pamphlet bids fair to be of general interest and value. The work was done jointly by the two agencies noted in the heading above. Two men from the division of state chemical research of the University of Kansas spent two years on a study of the operation of eight representative Kansas sewage-works. A considerable part of the pamphlet is taken up with a description of these plants and with test data.

Professor Haskins contributes a short discussion on "The Sewage Disposal Problem in Kansas." There are also chapters on sewage disposal practice in America, the operation of small sewage-works, the control of sewage-works by tests, and on the operation of automatic apparatus. A list of Kansas cities having sewerage systems is given, together with the method of treatment employed, if any, and the streams into which the sewage or the works effluent is discharged.

State Control of Stream Pollution

STREAM POLLUTION: A Digest of Judicial Decisions and a Compilation of Legislation Relating to the Subject—By Stanley D. Montgomery and Prof. Earle B. Phelps. Washington, D. C.: U. S. Public Health Service. Paper; 6 x 9 in.; pp. 408. From Superintendent of Public Documents, Washington, D. C. 30c.

Hearty welcome will doubtless be given to this useful digest of court decisions and compilation of legislation and rules now in force governing stream pollution. The court decisions are grouped under those based on the common law and those relating to state legislation. In each case a running summary is given by means of black-faced headings, accompanied by the authors' comments in larger type and extracts from court decisions in smaller type. This plan enables the reader to get the gist of the decisions quickly and easily or to go into the argument in detail, as time and need may require. The state legislation and administrative rules are presented by states, alphabetically, using material available at the Congressional Library up to Oct. 10, 1917.

Mathematics for Engineers

HANDBOOK OF MATHEMATICS FOR ENGINEERS—By Edward V. Huntington, Ph.D., Associate Professor of Mathematics, Harvard University. With Tables of Weights and Measures by Louis A. Fischer, B.S., Chief of Division of Weights and Measures, U. S. Bureau of Standards. Reprint of Sections 1 and 2 of L. S. Marks' "Mechanical Engineers' Handbook." New York: The McGraw-Hill Book Co. London: Hill Publishing Co. Flexible Leather; 5 x 7¼ in.; pp. 191; illustrated. $1.50.

Many civil engineers and various others who do not need the whole of Professor Marks' "Mechanical Engineers' Handbook" or who, having it, wish its sections on mathematics and weights and measures in more convenient form, will give hearty welcome to this volume. It is handy in fact as well as in name and may be slipped into a traveling bag or even a coat pocket without inconvenience. Illustrative of the utility of the book to those with no previous acquaintance with some of the subjects treated, the preface states: "The practical use of logarithms and logarithmic cross-section paper, and the elementary parts of the modern method of nomography (alignment charts)) can be learned from this book without the necessity of consulting separate treatises." Special features to which the preface calls attention are "the chapter on the algebra of complex (or imaginary) qualities, the treatment of the catenary (with special tables), and the brief résumé of the theory of vector analysis." The complete handbook from which the present volume is taken was noticed in *Engineering News* of Oct. 19, 1916, p. 747.

The Port and Terminal Problem of Today

PORTS AND TERMINAL FACILITIES—By Roy S. MacElwee, Ph.D., Lecturer in Economics and Foreign Trade, Columbia University; Associate Member, Society of Terminal Engineers and American Association of Port Authorities. New York: McGraw-Hill Book Co. London: Hill Publishing Co. Cloth; 6 x 9 in.; pp. 315; illustrated with 117 line cuts and halftones. $3 net.

"The port and terminal problem is one for both engineers and economists. There has been no real cooperation between the two sciences in the past. There has been a tendency to build wonderful piers as engineering structures which do not make up for the rest of the system, and there has been port planning which would not stand up because of the engineering deficiencies. The day has arrived when there must be a new profession of engineer-economist to solve involved transportation problems."

The foregoing paragraph from the preface is sufficient reason for the wide circulation of Dr. MacElwee's book among American engineers today. One criticism only may be made of the paragraph. The author, in common with many outside the engineering profession, assumes that an engineer is not an economist, that the engineer designs structures, purely as physical problems, and must combine in himself some other profession, or else must seek the aid of another profession, when he has to consider the economic problems of the structures he builds. So long as engineers remain in this limited field, just that long will they continue to be a minor profession. The real engineer is, in himself, an economist.

This introductory comment is but prefatory to a commendation of the book as a whole. It treats of what is perhaps the livest problem before the engineer today—the development of the ports of our country, a development which must follow the enormous increase in our merchant marine. While the author states that a future volume must deal with financing and administration, the present volume is devoted to the mechanism of the port development, rather than to the design of the port itself. Beginning with a brief description of certain of the world's leading ports, it passes to a detailed description of one of the port elements, that is, the harbor belt railway, and then discusses lighterage, cartage, drays, motor trucks, port, shed and warehouse equipment, the relation of the inland waterways to the seaport, and the development of industrial harbors and free ports. Brief references are made throughout to various mechanical and engineering details, but these are subordinated to the general mechanism of the port, with which the

author is obviously more familiar, although his chapters on mechanical handling of freight would indicate considerable experience.

A port is a harbor with terminal facilities, says the author. The construction of the harbor is obviously an engineering problem. So is the development of a port today, though not always so recognized by the public. Engineers who wish to impress upon the public and upon the business man who uses the port the truth of this statement must make themselves familiar with the principles laid down in Dr. MacElwee's book.

Cement Specifications Issued in Spanish

The Department of Commerce through the Bureau of Foreign and Domestic Commerce, Washington, D. C., has begun the issue of a series of Spanish and English pamphlets containing the English original and the Spanish translation of a number of American standards for construction materials. The first pamphlet is entitled "Standard Specifications for Portland Cement," prepared by the American Society for Testing Materials with the coöperation of the American Society of Civil Engineers, the Bureau of Foreign and Domestic Commerce and the Bureau of Standards.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

ANALYSES OF CANADIAN FUELS: The Maritime Provinces. Compiled by Edgar Stansfield, M. Sc., and J. H. H. Nicolls, M. Sc. Ottawa, Can.: Department of Mines. Paper; 7 x 10 in.; pp. 28.

THE BULK SHIPMENT OF GRAIN FROM THE COLUMBIA RIVER BASIN: Portland, Ore.: from Journal of the Oregon Society of Engineers. Paper; 6 x 9 in.; pp. 96; illustrated. 25c.

A commendable effort by an engineering society to bring agricultural and allied engineering home to farmers and shippers. Articles dealing more specifically with engineering subjects include "Country Grain Elevators," "The New Portland Municipal Elevator," "The Astoria Terminal Elevator," "Portland as a Seaport."

A CONVENIENT MULTIPLE-UNIT CALORIMETER INSTALLATION—By J. D. Davis and E. L. Wallace. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 48; illustrated. 15c.

DEPARTMENT OF LABOR, NEW YORK STATE, SPECIAL BULLETIN: Court Decisions on Workmen's Compensation Law, August, 1916—May, 1918. Part 1. Constitutionality and Coverage. Issued Under the Direction of The Industrial Commission, John Mitchell, Chairman. Albany, N. Y.: The Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 379.

DEPARTMENT OF LABOR, NEW YORK STATE, SPECIAL BULLETIN: Labor Laws Enacted in 1918—Issued Under the Direction of The Industrial Commission, John Mitchell, Chairman. Albany, N. Y.: The Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 71.

FIRE WASTE IN CANADA—By J. Grove Smith. Ottawa, Can.: Commission of Conservation. Cloth; 7 x 10 in.; pp. 304; illustrated.

Another example of the useful work being done by the commission named. Contains fire loss statistics, sections on "Building Construction and Fire Prevention," "Standardization and Testing of Structural Materials and Devices," "Prviate Fire Protection," "Municipal Fire Protection"; a list of notable conflagrations in Canada; and other pertinent matter.

FISHWAYS IN THE INLAND WATERS OF BRITISH COLUMBIA—By Arthur V. White, Consulting Engineer, Commission of Conservation. Ottawa, Can.: Commission of Conservation. Paper; 7 x 10 in.; pp. 14.

THE FRICTION OF WATER IN PIPES AND FITTINGS—By F. E. Giesecke, Head of the Division of Engineering, University of Texas. Austin: The University. Paper; 6 x 9 in.; pp. 42; illustrated. Free on application.

Has particular reference to the design of hot-water heating systems. Describes experiments and gives resulting data and conclusions.

GENERAL THEORY OF THE LAMBERT CONFORMAL CONIC PROJECTION—By Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: Superintendent of Documents. Paper; 5 x 8 in.; pp. 37; illustrated. 10c.

HINTS FROM A PRACTICAL FARMER TO THE SETTLERS ON THE PROJECTS OF THE UNITED STATES RECLAMATION SERVICE: Better Business, Better Farming, Better Living—By I. D. O'Donnell, Supervisor of Irrigation, U. S. R. S. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 137; illustrated.

INVESTIGATIONS ON SWIMMING POOLS AT THE UNIVERSITY OF MINNESOTA—By H. A. Whittaker, Director, Division of Sanitation, Minnesota State Board of Health. St. Paul, Minn.: The Author. Paper; 6 x 9 in.; pp. 12; illustrated.

LAMBERT PROJECTION TABLES FOR THE UNITED STATES—By Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: Superintendent of Documents. Paper; 5 x 8 in.; pp. 243; illustrated. 25c.

A MANUAL OF ENGINEERING DRAWING FOR STUDENTS AND DRAFTSMEN—By Thomas E. French, M. E., Professor of Engineering Drawing, The Ohio State University, M. Am. Soc. M. E.: Second Edition. Revised and Enlarged. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 310: illustrated. $2.50.

This edition contains a new chapter on lettering, a separate chapter on screw threads, bolts and fastenings, a rewritten and enlarged chapter on working drawings and a new chapter on structural drawing. The chapter on architectural drawing has been extended, new problems have been added in each chapter and some of the older ones redrawn to a larger size. Useful tables and diagrams have been placed in a short appendix. The volume throughout has a practical look.

MEASURING THE TEMPERATURE OF GASES IN BOILER SETTINGS—By Henry Kreisinger and J. F. Barkley. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 69; illustrated. 15c.

MECHANICAL DRAWING PROBLEMS: For High Schools, Normal Schools and Vocational Schools—By Edward Berg and Emil F. Kronquist, Instructors in Mechanical Drawing, Washington High School, Milwaukee, Wis.: The Authors. Cloth; 8 x 6 in.; pp. 223; illustrated. $1.

MINERAL PRODUCTION OF CANADA: Annual Report, 1916—John McLeish, B. A., Chief of the Division of Mineral Resources and Statistics. Ottawa, Can.: Department of Mines. Paper; 6 x 9 in.; pp. 343.

MINERAL RESOURCES OF ALASKA: Report on Progress of Investigations in 1916—By Alfred H. Brooks and Others. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 458; illustrated.

A NOTE ON THE HISTORY OF SUBMARINE WAR—By Sir Henry Newbolt—New York: George H. Doran Co. Paper; 5 x 8 in.; pp. 26.

PROBLEMS IN COST ACCOUNTING—By De Witt Carl Eggleston, M. E., Author "Municipal Accounting." New York: D. Appleton and Co. Cloth; 6 x 9 in.; pp. 337. $2.

THE PRESERVATION OF HOT WATER SUPPLY PIPE In Theory and Practice—By F. N. Speller, Pittsburgh, Pa., and R. G. Knowland, Boston, Mass. New York: The American Society of Heating and Ventilating Engineers. Paper; 6 x 9 in.; pp. 24; illustrated.

THE PROPERTIES AND TESTING OF OPTICAL INSTRUMENTS: Circular of the Bureau of Standards, Issued Aug. 9, 1918. Washington, D. C.: Superintendent of Documents. Paper; 7 x 10 in.; pp. 41; illustrated. 10c.

THE PUBLIC WATER SUPPLIES AND SEWER SYSTEMS OF MICHIGAN—By Edward D. Rich, C. E., State Sanitary Engineer. Lansing, Mich.: Michigan State Board of Health. Paper; 6 x 9 in.; pp. 40.

Gives ownership, source, treatment, if any, and remarks on water-supplies; tells whether sewers are separate or combined, estimated per cent. population served, and final outlet.

A RAPID METHOD OF PLOTTING COMBINED INDICATOR DIAGRAMS—By A. R. Munro, University of Queensland, Australia. Reprinted from *The Engineer*, London, Feb. 9, 1917. Brisbane, Australia: The Author. Paper; 6 x 9 in.; pp. 6; illustrated.

RELATION BETWEEN LOSS OF PRESSURE AND PIPE SIZE IN LONG STEAM LINES—By H. Eisert. From the *Journal* of the Engineers' Club of Baltimore, Dec., 1917. Baltimore, Md.: The Engineers' Club of Baltimore. Paper; 7 x 10 in.; pp. 19; illustrated. 25c.

REPORT OF COMMISSION ON THE REVISION OF RATES OF THE WASHTENAW GAS CO., ANN ARBOR, MICH. An Ordinance Regulating the Sale of Gas in Ann Arbor, passed Mar. 5, 1917—V. H. Lane, H. E. Riggs, R. K. Holland, Commissioners. Ann Arbor, Mich.: The Commission. Paper; 6 x 9 in.; pp. 39.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1915: PART XII. A—Pacific Slope Basins in Washington and Upper Columbia River Basin—Nathan C. Grover, Chief Hydraulic Engineer, G. L. Parker and W. A. Lamb, District Engineers. Prepared in Coöperation with the States of Washington, Montana, and Idaho. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 254; illustrated.

TESTS OF THE ABSORPTION AND PENETRATION OF COAL TAR AND CREOSOTE IN LONGLEAF PINE—By Clyde H. Teesdale, in Charge Section of Wood Preservation, and J. D. MacLean, Assistant Engineer in Forest Products, Forest Products Laboratory, Madison, Wis. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 42; illustrated. 15c.

WARTIME EMPLOYMENT OF WOMEN IN THE METAL TRADES. Research Report Number 8, July, 1918. Boston, Mass.: National Industrial Board. Paper; 6 x 9 in.; pp. 79.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Engineering Council Getting in Touch

By a long tour of the principal cities of the whole country, Alfred D. Flinn, secretary of the Engineering Council, has been acquainting various local groups of engineers with the centralized activities of the national engineering societies. "The greatest obstacle in the pathway to harmony and solidarity," he told the Twin City engineers at St. Paul, "are those valuable qualities of the engineer's character—his fertility of mind, his individualism and his reluctance to compromise." He concludes that a comprehensive organization is the best local. In some places the general local society comes first, and the sections of the nationals have later affiliated themselves with it. In others it has been found advantageous to unite separate organizations which have been established first, creating a club or association. In any scheme Mr. Flinn sees no reason why provisions cannot be made for general meetings or for civic or other local activities of common interest, while the several branches of the national societies can have meetings of their own devoted to their particular specialties.

Of the various groups addressed Mr. Flinn asked the following questions:

"Do you favor a central employment and personal information bureau for all engineers, with correspondents at selected centers, conducted in coöperation with the secretaries of the national engineering societies? Do you favor a central employment and personal information bureau for all engineers, with correspondents in selected centers, conducted in coöperation with the secretaries of the national engineering societies? Do you favor an Engineering Societies journal as a weekly medium for news and other matters of common interest to all branches of the profession, but not for technical papers presented before the societies? What more can the Engineering Societies library do for engineers at a distance? What additional work should the Engineering Council undertake? How can it better serve and coöperate with engineers at a distance from New York? What suggestions have you for the Engineering Foundation as to investigations of general application or research on broad lines? With whom can the secretary of the central organizations correspond as the representative of all engineers of your locality? If there is no one at present who can perform that function, cannot someone be chosen soon?"

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Marine Wood Borers Work in Deep Water

Sir—According to all published data the writer has seen and to his own earlier observations, the working range of the small marine wood borer is within or close to the tidal area, but a case has recently come to notice where the boring has not only taken place in deep water but has increased in amount with the depth.

In the Bay of Manati, on the north coast of Cuba, the Manati Sugar Co. built a pier of native hard woods in the year 1913 and in the spring of 1918 a part of it failed, requiring some rapid emergency work to enable sugar shipments to continue without serious interruption. Under ordinary conditions the hardwood piles supporting this pier should have been good for at least 15 years. When the pier was examined after the failure it was found that some of the piles in the apparently good sections had broken off, and upon removal they were found to be honeycombed by marine borers to an unusual degree and with most of the damage apparently in deep water and at or near the mud line. Eight piles were then pulled out of the structure from points that would fairly represent all parts of it, and they all broke off or pulled in two at the mud line. From these samples it was evident that all the piles in the structure were in a precarious condition.

The sample piles that had been pulled were sawed across at low tide level and at intervals of two meters from there down. They were found to be practically free from bores at low tide and above, but beginning at about low tide the boring was progressive with the depth and most pronounced at the mud line, as may be

UPPER VIEW SHOWS PILE CUT AT LOW TIDE LEVEL; LOWER VIEW SHOWS BORES SIX METERS BELOW LOW TIDE

seen from the accompanying photographs of a typical pile.

The bores are very similar to those of the limnoria, but I have never known it to work so deep nor to intensify its work as it went down, as in this case. Most of the bores are lined with mother-of-pearl which takes on color from the wood and is often a very beautiful pink when the boring is in one of the red woods; but this shell lining is quite common in the tropics.

It should be noted that the piles in this pier are not yet five years old and it is the worst case the writer has ever seen of destruction by borers in tropical hard woods. The rapidity with which these piles have been destroyed and the unusualness of the borers' operations would suggest a new variety. There seems to be no reason why the Bay of Manati should have monopoly of this little destroyer. Like many of the bays of Cuba it receives no fresh-water stream sufficient to dilute it, has no city on its shore to pollute it, and, owing to the slight range of the tide and the narrow harbor mouth relative to the area of the bay, the water must be changed quite infrequently.

It is thought this bit of experience may be of interest to your readers and may perhaps be the means of bringing out some further information on the subject.

ARTHUR S. HOBBY,
With The Snare & Triest Company.

Havana, Cuba.

Part Ownership of the Railroads

Sir—As a compromise between the "It shoulds" and the "It shouldn'ts," may I advance the idea of a partial Government ownership of railroads, sufficient to give it controlling powers? I am against absolute ownership by the Government. I cannot believe that a post-office department or a railroad can be operated by a man who must depend upon knowledge of its affairs gained from experts, who have no interest beyond retaining their salaries, as efficiently as a man can operate a railroad from intimate personal knowledge gained by experience and assisted by those whose interest is only limited by their individual ability to gain the highest reward. And railroads under political control could easily become a tremendous factor of evil. C. E. NEWELL.

New Orleans.

The United States Engineer Officer Who Located the Mexican Railway

Sir—The interesting account of the engineering experiences of Rudolph Hering and his associates forty years and more ago encourages me to send you some interesting facts regarding the distinguished American engineer to whom credit is due for locating the Mexican railway from Vera Cruz to the City of Mexico. It is generally supposed in Mexico that this remarkable piece of location work was done by English engineers, the road being owned by an English company, but the fact is that the location was made by Capt. Andrew Talcott, who was one of the earliest members of the Corps of Engineers, United States Army.

Mr. Talcott was born in Connecticut in 1796 and was graduated from West Point in 1818, being commissioned in the Corps of Engineers. He served in that corps for some twenty years, receiving his captain's commission in 1830. While serving as astronomer on the survey of the boundary line between Ohio and Michigan, he originated the Talcott method of determining latitudes by observing the difference of the meridianal zenith distances of two stars on opposite sides of the zenith. He used in this work an equal altitude instrument made by Troughton & Simms, of London. The same method was afterwards used by him on other Government surveys and after several years' trial in the Coast Survey was officially adopted by it in 1851.

Captain Talcott's early experience in railway work was as adjunct chief engineer of the New York & Erie R.R. in 1836-37. In 1848 he was made chief engineer of the Richmond & Danville R.R. in Virginia, and held that position seven years. He was chief engineer of the eastern division of the Ohio & Mississippi R.R. in 1856-57, and in the latter year became chief engineer of the Mexico & Pacific Ry., which undertook the location of the line from Vera Cruz to the City of Mexico. For the next ten years a large part of his time was devoted to this work in conjunction with an engineering staff largely recruited from the United States. During the French occupation of Mexico he was engaged in constructing the portion of this railway between Puebla and the City of Mexico. He was "joint engineer" in conjunction with James Samuel of the Imperial Mexican Ry. in 1867, at the time the work was suspended on the withdrawal of the French Army.

Captain Talcott died in Richmond, Va., Apr. 22, 1883.

Buffalo, N. Y. EMILE LOW.

To Find the Diagonal of a Rectangle With the Slide Rule

Sir—I have a slide-rule solution of a common problem that is original with me, so far as I know. The problem of finding the square root of the sum of the squares—that is, to find the length of the diagonal of a rectangle, having given the lengths of the sides—is an unpopular one, owing to the different steps involved, but not an unusual one. When sufficient accuracy is obtainable with the slide rule, the problem is quickly solved.

Let H and V be the quantities the square root of the sum of whose square is desired. On an ordinary slide rule, designate the full scales by the letters C and D and the squared scales by the letters A and B, or $D^2 = A$ and $C^2 = B$. Divide H on the D scale by V on the C scale. On the A scale opposite the index of the slide note $(H/V)^2$. Mentally note position of the decimal point. Set the index of the slide at this plus unity, or $(H/V)^2 + 1$, likewise on the A scale. On the D scale, opposite the quantity V on the C scale, read the answer, or $\sqrt{H^2 + V^2}$.

For example, find the length of the diagonal of a rectangle whose sides are 15.7 ft. and 22.4 ft. Over 15.7 on the D scale set 22.4 on the C scale. The quotient squared is 0.492. Set the slide's index at 1.492 on the A scale and at 22.4 on the C scale, and read the answer, 27.35 on the D scale. The length of the diagonal is 27.35 ft.

The proof is apparent, in that $V\sqrt{(H/V)^2 + 1} = V\sqrt{(H^2 + V^2)/V^2} = \sqrt{H^2 + V^2}$.

Berkeley, Calif. J. R. JAHN.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Center of Gravity of Stock Piles Economically Important

FOUR times as many pounds of stone and three times as many pounds of sand as of cement are used on an average in making concrete. Perhaps twice in three times, in concrete construction, the stone pile is located farthest from, and the cement stock nearest to, the mixer, with the sandpile occupying a midway position. Just this situation was found on a job recently visited where the materials were handled with wheelbarrows. To charge the mixer, four pounds of stone had to be moved three times as far and three pounds of sand had to be moved twice as far as one pound of cement. Work equals weight in pounds multiplied by distance moved in feet. On the job in mind, then, the total units of work of moving aggregates and cement was 19. Had the stone pile been nearest the mixer, and the cement stock farthest from it, the total units of work moving materials would have been 13. This comparison offers a suggestion for economical stockpile location.

C. S. H.

Other Articles of Interest to Contractors In This Issue:

Boston Army Supply Base Will Be Valuable Permanent Port Terminal — Page 522

Contract Organization Vitally Important for War Work — Page 535

Labor Shortage Made Good by Station Contract System — Page 542

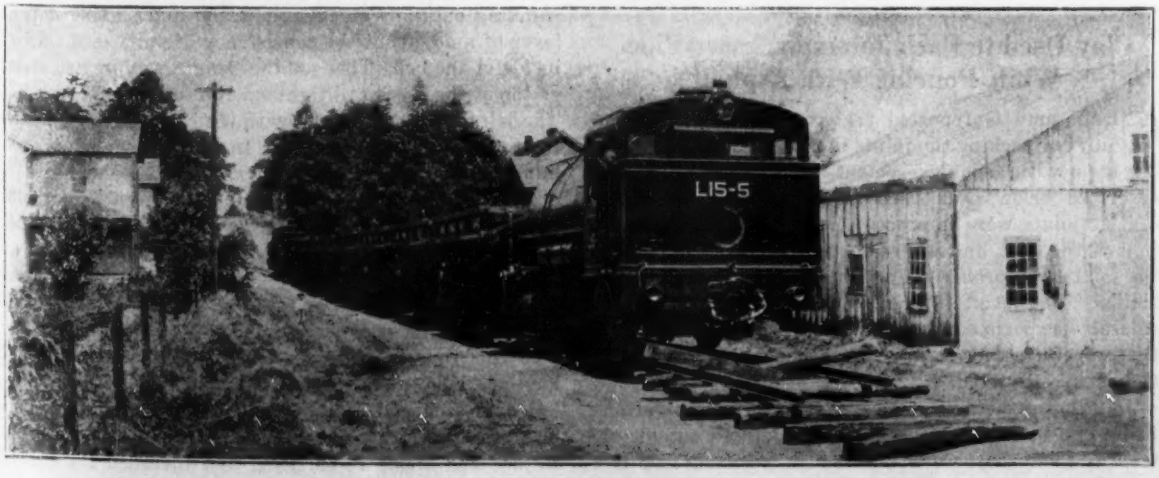
Moving a Construction Train Three Miles Cross Country

HEAVY single pieces of construction machinery are very frequently moved long distances under their own power, but it is not often that a whole construction train is transported cross country as a unit. How this has been done at the Germantown dam for the Miami Conservancy District in Ohio is described in a recent issue of the *Miami Conservancy Bulletin.*

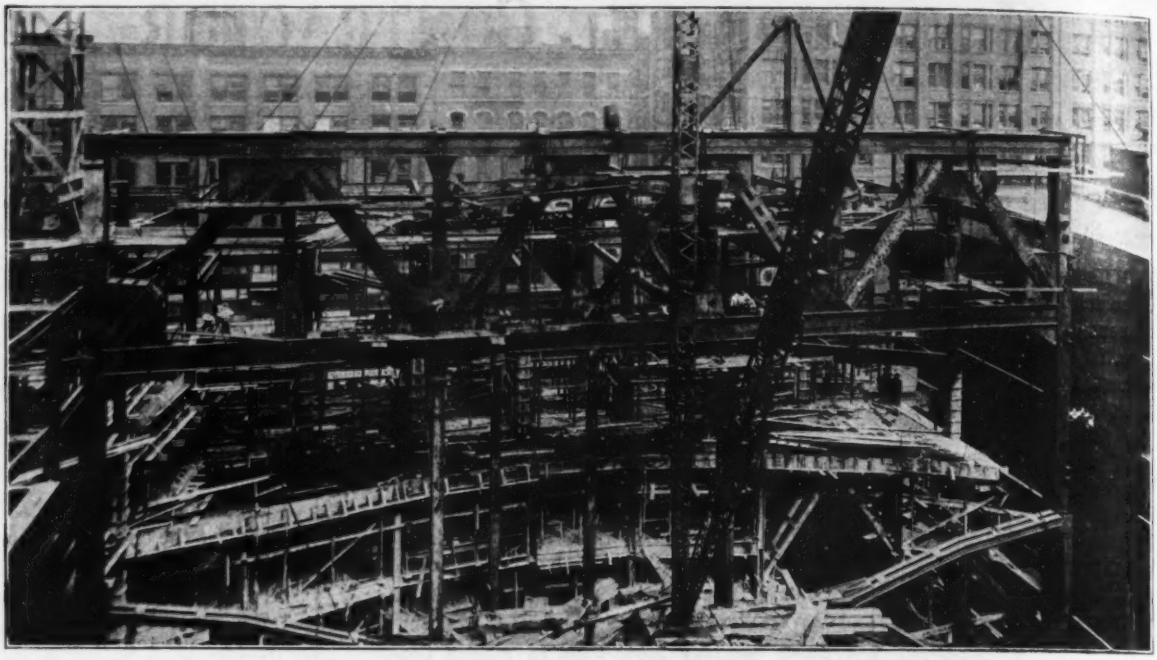
No railway runs near the site of the dam, so it was necessary to run a standard-gage construction train, with two locomotives, on its own tracks and under its own power on the country highway and village streets, about 3½ miles. The distance was not covered in one run but in short lengths, the rails being taken up behind the train and relaid in front as the journey proceeded. Grades were encountered that were too steep for the entire train to climb, even when driven by both locomotives. To overcome this a siding had to be built at the top of the hill seen in the background in the view. The front locomotive dragged the cars up the slope one at a time and stored them on this siding, where they were made up once more into a train and moved ahead again out onto the main line.

Guy Derrick Places 75-Foot Truss in Chicago Theater

HOISTING a complete truss into position as part of the framing of a building was one of the features of the erection of the State-Lake Building in Chicago, which includes a theater surmounted by office floors. Over the stage front is a 75-ft. truss, 17 ft. deep, framed between a pair of box columns. This truss was assembled at the basement level, about 6 ft. in front of the columns. No end connection plates were fitted, as



STANDARD-GAGE CONSTRUCTION TRAIN ON ITS WAY TO GERMANTOWN DAM OVER COUNTRY ROAD



STEEL TRUSS 75 FEET LONG HOISTED INTO PLACE ON CHICAGO THEATER BY GUY DERRICK

these plates were riveted to the columns after their erection.

For lifting, a single hitch was taken at the center of the top chord. The truss was raised high enough to clear the connection plates on the columns, as shown in the accompanying view, and was then lowered till the rivet holes in the chord and end posts registered with those in the plates. Each of these members consists of a pair of channels, which channels are outside of the plates.

A steel guyed derrick was used, having a 100-ft. boom and 112½-ft. mast, both of box lattice construction. Its hoist is operated by a 100-hp. electric motor. The weight of the truss was 40,800 lb. This work was done Aug. 20, by the Longacre Construction Co., which is using two of these derricks on the steel erection work. Lieberman, Klein & Hein are the structural engineers.

Clay Used to Pack Joints in Sewer-Pipe While Pouring With Asphalt

CLAY mud is reported to have been used successfully for packing the joints in sewer-pipes while pouring them with asphaltic cement. The method, which is described below, was used at a nitrate plant where cement joints were impracticable on account of the action of the acid, and where the use of jute for packing the joints was prohibited as likely to form an explosive similar to guncotton and blow up the sewer. Considerable experimentation was necessary to determine the proper packing to hold the asphalt joints, and clay was finally selected.

Jointing of the pipe was carried on in two operations. From one to four lengths were first jointed outside the trench, then they were lowered to position and connected with the sewer already in place. On sizes from 30 to 36 in. it was found that two joints were about as easy to handle as one in lowering into the trench. With 24-in. pipe, it was found feasible to joint three lengths outside the trench, and with 18-, 15- and 12-in. four lengths could be used, provided the trench was 10 ft. or more deep. When the trench was shallow, it was found better to joint two lengths, place them in the bottom of the trench and then joint two more and place them on top. This removed the bother of trying to keep them from falling over when the smaller sizes were handled. Anything above 15 in. would stand alone four lengths high.

Equipment for carrying on this work consists of a portable asphalt kettle and some long-handled dippers, holding about a gallon of asphalt, to carry and pour the joints. The dippers had three spouts to allow pouring from either side or the end.

The joints to be made above ground were made by standing one pipe on its spigot end and putting a thin layer of mud, about the consistency of putty, around the inside of the bell. Then another length was pressed down on top of the clay until tight enough to overcome leaking. The joint was then poured with the liquid asphalt, which cooled almost immediately. In this way any desired number of joints were connected above ground.

After the pipe was lowered into the trench the most difficult job was to form the trench joints so that they would not leak. Regular asbestos runners, the same as used with lead joints, were used for the small sizes of pipe to dam the asphalt at the outside of the joint. Sisal or manila rope was used for the larger sizes. To hold this rope in place an angle iron about 4 in. long, having a hole in one end and a slot in the other, was fastened to each end of the rope, through which a U-bolt was passed to draw the rope up. This U-bolt was ½ in. in size and about 10 in. long, and threaded for nearly its entire length to allow for taking up. By having a hole and a slot, it was possible to pull out the slot end

as soon as the joint cooled, while with holes in both ends it was hard to get the bolt out on account of the asphalt holding it.

In making the trench joints, clay was put in the bell as in the work outside, and on the larger sizes of pipe a man went inside to mud up the joints. He remained there while the joints were being poured. With the smaller sizes, the ends were mudded before being placed, and after being placed the joint was calked up from the outside with mud, by means of a small stick. It was necessary to cover all crevices between the ropes and the pipe with mud, to stop the leaks.

It is pointed out that asphalt for pouring the joints should be very hot, so that it will not cool before it reaches the bottom. It should be poured slowly while watching for leaks, which in the larger sizes of pipe may be seen from the inside, but in the smaller sizes must be gaged by the amount of asphalt used, and by watching for smoke from the upper end of the pipe. In the case of small leaks, these may be stopped by discontinuing pouring for a minute or two while they cool sufficiently to heal themselves.

After the ropes were placed and mudding up was done on the larger sizes of pipe, it was necessary to build almost solid from the ropes to the subgrade to keep the mud from drying up and falling off. This was required on the large sizes of pipe, on account of the slow cooling of the greater body of asphalt. When the asphalt had cooled the ropes were removed by loosening the U-bolt and giving it a jerk.

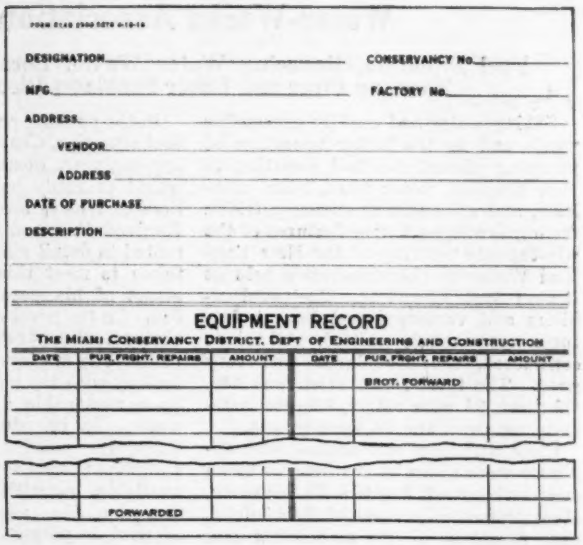
Equipment Cards Carry Cost History of Plant Items

EQUIPMENT cards carry the cost history of every principal item of plant employed on the construction work of the Miami Conservancy District. By means of these cards the plant cost of any item of equipment at any period of its service can be determined, its various transfers can be known, and its successive custodians can be identified.

On the conservancy work all equipment of whatsoever nature when placed in use, whether installed as a part of a plant or used independently as a unit, is taken into the plant account. Each item is then gradually absorbed into a construction feature cost as the work progresses, until upon completion of the job the entire installation cost is accounted for and only the salvage value of the item remains in the plant account. Depreciation is included in this absorption.

Installation cost, as the term is employed above, includes purchase and erection cost, costs of transportation and major repairs and, indirectly, depreciation. Observe here that an item of equipment enters plant account only when it is assigned to a plant or is placed in use. The value of new equipment not in use and of old equipment in hand after dismantling of plant is carried in the general ledger account under "equipment."

Upon the addition to the plant of each item of equipment a card is prepared for it as a drag line, locomotive, motor truck, concrete mixer, etc. The face of this card is reproduced here. On the back are the headings "Appraisals," "Memo-Record of Charges for Use of Equipment" and "Disposition." The face of the card carries the full plant cost record of the item while that item remains a part of the same plant. When transfer is made to another plant, appraisal is made of the value of the item and the amount is charged to the new plant and credited to the old one. The particulars of the transfer, the appraised value and the place to which removal is made are entered on the card, and a


DESIGNATION _____ CONSERVANCY No. _____

MFG. _____ FACTORY No. _____

ADDRESS _____

VENDOR _____

ADDRESS _____

DATE OF PURCHASE _____

DESCRIPTION _____

EQUIPMENT RECORD

THE MIAMI CONSERVANCY DISTRICT, DEPT OF ENGINEERING AND CONSTRUCTION

DATE	PUR. FRGHT. REPAIRS	AMOUNT		DATE	PUR. FRGHT. REPAIRS	AMOUNT	
					BROT. FORWARD		
	FORWARDED						

CARD USED TO RECORD HISTORY OF CONSTRUCTION EQUIPMENT

new card is prepared for the record of the new plant. Thus the cards always remain a part of the permanent record, and when an item is finally dismantled and disposed of such disposition is entered on the card.

By use of the cards responsibility for unexpandable equipment can readily be placed. The accounting records are supported by separate card records. A duplicate in the general office files gives immediate information, concerning any item, to the engineering construction department. Another copy goes with the item when it is transferred and gives the new custodian all necessary information.

These equipment cards are a part of the cost accounting system of the Miami Conservancy District, of which Arthur E. Morgan is chief engineer. Charles H. Paul, assistant chief engineer, was chiefly responsible for the development of the accounting system of the district.

Strengthen Bridges for Motor Trucks

Increasing use of motor trucks and tractors on public roads has led the Missouri State Highway Department to issue a notice calling the attention of county highway engineers and road overseers to the necessity of looking carefully after the condition of bridges and culverts. The department requires all new structures on state roads to be designed for a 15-ton load, but replacement of those structures which are too light for this load is not insisted upon, if they are safe for ordinary traffic. The existing bridges must be utilized in order to get the benefit of the state roads, but it is planned to bring them up to standard as fast as money becomes available.

NEWS OF THE WEEK

New York, September 19, 1918

Win-the-War Meeting Held by New England Water-Works Association

Fuel Situation, Reducing Water Waste, Locating Leaks, Thawing Pipes and Labor Problems Discussed

Saving water and coal by preventing waste and by the better operation of pumping plants, the fuel situation in New England, water rates, labor problems, and evidences of strong patriotic feeling throughout were features of the win-the-war meeting of the New England Water-Works Association held at Boston Sept. 11 and 12. The usual exhibits and various entertainment features were entirely omitted. All things considered, the attendance was very good. The total registration was 146. Of these, 94 were active, 32 were associate members and 20 were guests.

Close attention and enthusiastic applause were given by the hearers to an address by Prof. William T. Sedgwick, Massachusetts Institute of Technology, past president of the association and chairman of the Massachusetts division of the National Security League. The address was entitled "From Peace to War, from War to Victory, from Victory to Judgment." It reviewed the causes of the war and the conduct of Germany before and during the conflict. The necessity for punishment of Germany was urged; not in the spirit of revenge, but for the same reason as the criminal is punished anywhere and everywhere in civilized society; that is, for the prevention of crime.

The Fuel Problem in New England

No other subject was given more attention by the meeting than the fuel problem. The coal situation in New England was reviewed briefly by Ira M. Hollis, President of Worcester Polytechnic Institute. Suppression of industry and elimination of coal consumption is not coal conservation, in his opinion, nor is using wood or finding any other substitute. Conservation rather is a matter of stopping waste. As an illustration of what can be done, President Hollis said that last December a certain contractor was using coal at the rate of 950,000 lb. a month. A local committee was appointed to study the subject and effect reductions, with the result that the March coal consumption was only 550,000 lb.—March and December being much alike. This is a shameful confession, President Hollis said, especially in view of the fact that last winter wounded soldiers in hospitals in Italy had no heat whatever. The question which should be constantly before us is, Are we doing all we can so our boys can come home?

In the opening part of a paper on the fuel situation, Charles T. Main, consulting engineer, Boston, stated that there would probably be a shortage of millions of tons of bituminous coal in New England this coming season. He presented in detail measures which may be taken to meet this situation. An abstract of his paper appears on page 530. On the preceding page appears an abstract of a paper by George A. Carpenter, city engineer of Pawtucket, R. I., dealing with the possible saving of coal by a reasonable curtailment of water waste. In introducing his paper, Mr. Carpenter pointed out the fact that statistics needed for his study were not available, notwithstanding the adoption by the association of forms adopted to present such figures in annual reports.

Report of Committee on Frozen Water Mains

After the severely cold spell last winter the association appointed a committee to investigate and report on the subject of frozen water pipes. The report of the committee was submitted by its chairman, Frank J. Gifford, superintendent of water-works, Dedham, Mass. Mr. Gifford stated that the committee sent out 215 inquiries and received 95 replies. Very few superintendents ever experienced such extremely cold weather before. An abstract of the report appears on p. 530.

In the discussion of the report Frank McInnes of Boston, a member of the committee, said he was impressed with the need for all possible data as to how water pipes can be thawed by electricity without damage. He had found the use of a storage battery apparatus very successful in Boston last winter, but this device proved to be dangerous unless properly operated. It is too delicate an apparatus for general use. A paper on "Detecting Leaks in Underground Pipes" was presented by David A. Heffernan, superintendent of water-works, Milton. It is abstracted on p. 528. Several members spoke favorably of the use of water-leak locators.

A description of quartermaster terminals required for war work was the subject of an address by Maj. Charles R. Gow, construction quartermaster, Boston. The construction of the Squantum destroyer plant was described by Thomas C. Atwood, resident supervising engineer. Major Gow remarked that with 5,000,000 men overseas it would be necessary to ship 125,000 tons a day of supplies. This would require one train of 40 cars every 12 min. in the 24 hr. or 21 6,000-ton cargo ships per day, and the continuous service of about 600 ships.

The Squantum destroyer plant, Mr. Atwood said, was entirely covered in, both ways and wet basins, at an extra cost of $2,000,000 for roofing. This extra cost would be paid for if destroyer construction was speeded up sufficiently to save only one ship from destruction.

A Radical View of Meter Rates

In the course of a talk on the need of higher water rates to offset increasing cost, John J. Moore, consulting engineer, Boston, spoke very strongly against supplying water in large quantities at a reduced rate. He said that if meter rates were to slide they should slide downward or with decreasing consumption, rather than downward with increasing consumption. The reason that he gave for this was that in the case of many works the large consumers make a heavy demand upon the supply which oftentimes entails an increase in the capacity of works at a very large expense. He favored a flat meter rate. Several speakers agreed with him.

Mr. Moore also urged the general proposition that where it is necessary to get more water revenue by increasing rates the increase should be in the nature of hydrant rental instead of raising the rate for domestic and industrial uses. Private water companies, Mr. Moore said, are having to pay largely increased taxes compared with a few years ago. Their property is assessed at its full valuation, whereas other property in the same community is assessed at only a percentage of the value.

Water-Works Labor Troubles

Opening a discussion on this subject, C. E. Davis, chief of the Bureau of Water, Philadelphia, and president of the association, said that an effective pension system in Philadelphia had had a stabilizing effect on the employees. It has kept many of them from going into private employment even at much higher rates of pay. C. A. Bingham, city manager, Waltham, Mass., said that in his city, with a pension system in force, out of 100 employees, 60 were working, 30 were out on strike for more pay, and 10 were on the fence. If the demand for higher wages were to be granted, it would add $7500 a year to the payroll. There was no money available to meet the

(Concluded on page 558)

Motor Transport Service Needs Recruits

Each American Army Requires 154,747 Officers and Men With Motor Vehicles Numbering 79,500

Thousands of men for the Motor Transport Corps, which was formed recently, are required by the Government. The number of men required for each American army is 154,747, and the number of motor vehicles required for each army is 79,556. Men qualified to drive motor vehicles are needed by the thousands and will continue to be, while men who have good executive experience in business are specially wanted for officers. Many men who were given deferred classification in the first draft, but who now wish to get into the army, are, it is stated, finding excellent opportunity for service in this corps.

The immense scope of this organization is shown by the fact that when the American army numbers 4,000,000 men nearly half a million or one-eighth of the entire force will be in this service. These figures do not include the corps operating in the United States, which has an average of 1500 trucks working in convoy trains.

The vehicle equipment for each army is as follows: Motor trucks, 40,803; motorcycles, 24,215; passenger-carrying motor cars, 7905; ambulances, 6598. These will require approximately 100,000 drivers and riders. The officers will number 4298 and the non-commissioned officers 30,090. Besides this, the headquarters and executive organization will consist of 3122 men and 679 officers, and the total repair personnel in the 273 service parks provided for upkeep will consist of 34,319 men, many of whom must be mechanics.

This corps is cor idered of the greatest importance, and recent events in France have proved its increasing usefulness, and many instances are on record where it has saved critical situations. Those interested in the service can secure information from the Chief of Motor Transport Corps at Washington.

Colored Insert — Liberty Asks for Billions

Published as a supplement to this issue is another patriotic poster in colors, portraying Liberty speaking in behalf of the Fourth Liberty Loan. In the poster, Liberty says billions of dollars are needed and needed now—needed that our armies may win the victory that can be won only by "Force, force to the utmost; force without stint or limit," using the words of President Wilsor

North Western First Railroad to Accept Standard Contract

The Chicago & North Western Ry. has notified the United States Railroad Administration of its acceptance of the standard contract. It is the first railroad to do so.

All Construction Must Be Essential to the War

War Industries Board in New Ruling Delegates Authority to Pass on Proposed Construction to State Defense Councils

(Washington Correspondence)

Non-war construction is to be stopped immediately by the War Industries Board. Important projects already under way will in all probability be allowed to continue, and no work will be shut down where such stoppage will entail dangerous conditions or great depreciation when work starts again, but every proposed piece of construction will have to satisfy the criterion of essentiality to the war before being allowed material, and without material construction cannot go ahead. Already the Capital Issues Committee restricts the unnecessary use of capital and the United States Employment Service is curtailing the diversion of labor to non-essential industries; the control of material by the War Industries Board is the final bar to non-war construction.

By an order of the War Industries Board dated Sept. 12 the primary control of material is to be vested in the various state councils of defense. Upon their favorable recommendation the War Industries Board will consider any proposed construction, and if satisfied of its essential nature will issue the permit which is necessary before any material can be obtained for the work. If the State council is unfavorable to the proposed construction the new order infers that the project is dead, so far as material is concerned, although there will undoubtedly remain the right of appeal to the War Industries Board in special cases. The War Industries Board may also decide against a project favorably reported by the State council, in which case also no material will be allowed.

Government Work and Roads Excluded

The new ruling applies to all forms of projected construction except that it does not include undertakings directed by, or under contract with, the War Department, Navy Department, Emergency Fleet Corporation, Bureau of Industrial Housing and Transportation of the Department of Labor, the United States Housing Corporation, and the following civilian enterprises:

Repairs of or extensions to existing buildings involving in the aggregate a cost not exceeding $2,500.

Roadways, buildings and other structures undertaken by or under contract with the United States Railroad Administration or a railroad operated by such administration.

Those directly connected with mines producing coal, metals and ferro-alloy minerals.

Public highway improvements and street pavements when expresely approved in writing by the United States Highways Council. These latter have to pass through the State highway commissions for preliminary approval.

The ruling furthermore applies only to projected buildings and not to those already begun. Where a substantial portion of a building has already been constructed, manufacturers and distributors of and dealers in building materials may continue to furnish such materials for the completion of such building, pending further action by the War Industries Board.

State Defense Councils Important

The regulations governing the operation of this ruling are given as follows:

"Any person interested in a construction project must apply, with a full statement of the facts under oath, to the appropriate local representative of the various State councils of defense. This representative will investigate the necessity of the proposed construction and transmit recommendations to the State council for review. The State council will review the case, and if it decides in favor of the construction it will at once send its recommendation, with a full statement of all the facts, to the Non-War Construction Section of the Priorities Division of the War Industries Board. The Non-War Construction Section will grant or withhold the permit and so notify the State council of defense, and the individual concerned. If the State council decides against the proposed construction, it will notify the person concerned that his project has been disapproved.

"The War Industries Board will inform all persons applying directly to it that they must first take up their projects with the appropriate local representative of the State council of defense."

It is further stated that the "ability of the War Industries Board to enforce this whole plan rests upon the fact that it controls priorities and has also secured from the manufacturers of building materials a pledge not to supply materials for projects which are not authorized under the regulations of the War Industries Board."

What the New Order Means

This drastic control, the correspondent has been informed by one intimately connected with the War Industries Board, has been forced indirectly by the shortage in labor. Practically every war industry is working far under a 100% capacity because it can not get men. The duration of the war, which should be measured in lives of American soldiers as well as in days and months, is being lengthened by this lack of labor. Every construction project which is not contributing to the war is diverting from these necessary industries not only the men who are working on the non-essential project itself

(Concluded on p. 558)

Engineering Co-operation at San Francisco

Joint Council from Sections of Five National Societies Organized—Aims Stated

Five national engineering societies which have San Francisco sections on Sept. 4 organized what is to be known as the Joint Council of the Engineering Societies of San Francisco. The societies represented are the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Chemical Society. Four representatives from each of these societies, constituting 20 men in all, form the Joint Council, which, in turn, is officered by an executive committee of five. The members of this executive committee are C. D. Marx, chairman; E. C. Jones and E. C. Hutchinson, vice-chairmen; N. A. Bowers, secretary-treasurer, and E. O. Shreve, assistant secretary.

This organization is the culmination of several meetings of the secretaries of the five societies involved, at which plans for more effective inter-society coöperation have been worked out. Some of the expected advantages are a closer touch among members of the several associations; putting of the several employment bureaus together in one central office; joint meetings to discuss subjects of common interest; coöperation for the sake of economy, such as in mailing notices, and consolidating headquarters at the Engineers' Club.

In a paper on this subject read at a recent joint meeting, it was pointed out that "Membership in a national engineering society has always carried with it a certain amount of prestige. Here in the Far West we have been content with but little besides that as a return for our annual dues.

"Our parent societies have joined in forming the United Engineering Society, and the plan has proved eminently successful from every angle. May we not begin now to lay the foundation for branches of that organization in Western centers? Why not the San Francisco branch of the United Engineering Society? At least we may suggest this as an ultimate possibility; another incentive among the opportunities that await our pioneer joint council."

The Joint Council will have regular meetings once a month, the executive committee convening at the pleasure of its members. The constitution tentatively adopted at the Sept. 4 meeting sets forth as the purposes of the organization:

1. To foster closer relationship among the engineering societies of San Francisco, especially in those matters
   - (a) where coöperation will make for more efficient "win the war" service;
   - (b) where coöperation will make for more efficient service to the state of California, its cities and counties;
   - (c) where coöperation will expedite progress toward those ideals common to our several organizations.

2. To plan and carry out arrangements for joint meetings of the several societies whenever such meetings are deemed advisable, and to endeavor to make joint meetings effective in developing closer relationships among members of the several societies.

3. To act generally as the clearing house for matters which involve the several societies, especially where the common good will be enhanced by working through an executive head representative of the several organizations.

The first act of the Joint Council was the decision to urge upon the Governor of the State the appointment of an engineer as member of the State Railroad Commission. In making this recommendation it was pointed out that "the best interest of the State would be served by the appointment of engineers as members of commissions dealing with problems the solution of which requires technical training and experience," and that the appointment of an engineer to fill one of the vacancies on the State Railroad Commission would doubtless "be regarded by the people of the State as indicating a wish to place the public service on the highest plane of efficiency and will be creditable both to the appointing power and to the engineering profession."

Seattle Votes Port Improvement Bonds

At the election of Sept. 10 the voters in the Port District of Seattle, Wash., approved the proposed bond issue of $3,240,000 for new port improvements in the Smith's Cove Terminal and also $1,125,000 for the purchase after the war of the warehouse to be built for the present emergency by the War Department.

Construction Must Be Essential

(Concluded from p. 557)

but the labor of all the men who produce the materials which go into the project. In many cases the actual workmen are local men who, with any power now available, cannot be made to leave local work or who are too old or unskilled for any other work; the argument is sometimes made to the board that their services on the project in question do not in any way interfere with the war program. In answer the boards say that while they may not be of any use to some war industry, in many cases the materials they are working with, the brick, the cement or the steel or the labor to make these materials and the cars or motors and men to transport them, should now be going into work which will hasten the end of the war. It is recognized that the enforcement of the order may in some cases result in casualties to established businesses, particularly to contractors whose organizations will be disrupted and whose equipment will deteriorate, but this, in the opinion of the board, must be considered as one of the many deplorable results of war. Labor must shift to war industry; contractors must find war work.

New England Water-Works Meeting

(Concluded from p. 556)

increase. A speaker from Woburn said that the minimum wage had increased there in the last three years from $2 to $3 a day. The men got a raise to $3 by threatening a strike after the mayor had refused to grant the increase. Some of the men were disappointed because there was no strike. Later a demand for $3.50 a day was made, and the mayor was advised to grant the increase but he refused and some of the men have already quit to work elsewhere for higher wages. The speaker urged that men in municipal employ should be regarded as on a different basis than those in private employ, since the former are really municipal stockholders. John M. Diven, superintendent water-works, Troy, N. Y., and secretary of the American Water-Works Association, said that most of the water-works are operated on the budget system, making it hard to increase wages on demand. In Troy a wage increase has been granted three times of late. This has been made possible by cutting down work and keeping the best men.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Chicago.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

CITY MANAGERS' ASSOCIATION; Harrison Grey Otis, Auburn, Maine, secretary-treasurer; Nov. 6-8, Roanoke, Va.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

The American Public Health Association will hold its annual meeting in Chicago Oct. 14 to 17 and not in Boston, as mentioned in the Engineering Societies Calendar in the past few issues of *Engineering News-Record*.

The Engineers' Club of Philadelphia held a joint meeting with the American Institute of Electrical Engineers

and the Association of Iron and Steel Electrical Engineers in Philadelphia Sept. 16, at which H. A. Hornor presented an illustrated paper on electric welding. Mr. Hornor's paper dealt with the applications of welding to the shipbuilding industry. Charles M. Schwab, director general, Emergency Fleet Corporation, presided. The next regular meeting of the club will be held Oct. 15.

The **Juneau Society of Engineers**, Juneau, Alaska, recently held a farewell banquet for H. P. Crowther, J. P. Walker, Frank P. Metcalf, V. N. Dupuy and R. G. Wayland, who had passed examinations for commissions in the Corps of Engineers.

The **Louisiana Engineering Society** held a meeting in New Orleans Sept. 9, at which Charles W. Okey's paper, entitled "Main Drainage Channels for Reclaimed Areas of Southern Louisiana," was discussed by Messrs. Dusenbury, Kerr, Klorer and Lawes.

The **Youngstown Engineers' Club**, Youngstown, Ohio, elected the following officers at a meeting held Sept. 7: President, F. W. Funk; vice-president, W. H. Ramage; secretary-treasurer; R. H. McCarty.

PERSONAL NOTES

LOUIS J. HOROWITZ, president of the Thompson-Starrett Construction Co., New York City, has been appointed special assistant to the chief of ordnance, in charge of tanks, in which capacity he will have authority to decide all questions pertaining to the engineering, manufacturing and inspection of tanks.

C. A. MORSE, chief engineer of the Chicago, Rock Island & Pacific Ry., and president of the American Railway Engineering Association, has been appointed manager of the newly-created maintenance of way section, division of operation, United States Railroad Administration. Mr. Morse was born in Maine in 1859, and was graduated from the University of Maine in 1879. His first six years after graduation were spent in various railroad work. In 1886 he began a 27-year period of service with the Atchison, Topeka & Santa Fé Ry., rising from division engineer to chief engineer of the system. In 1913 he left the Santa Fé to become chief engineer of the Rock Island. Last March he was elected president of the American Railway Engineering Association.

LIEUT.-COL. LINCOLN BUSH has been promoted to the rank of colonel in the Quartermaster Corps. Colonel Bush has been in the Construction Division of the army since early in the war, assigned to port and terminal work.

MAJ. F. G. JONAH, Corps of Engineers, previously chief engineer of the St. Louis & San Francisco R.R., has been promoted to the rank of lieutenant-colonel.

MAJ. T. L. HUSTON, Corps of Engineers, previously a New York contractor who had had long experience in Cuba following the Spanish-American War, in which he served as a captain in the 2nd United States Engineers, has been promoted to the rank of lieutenant-colonel. He has been in service in France since early in the war. Lieutenant-Colonel Huston is one of the two joint owners of the New York American League Baseball Club.

MAJ. H. F. CAMERON, Engineers, U. S. A., has been promoted to the rank of lieutenant-colonel. Colonel Cameron for many years has been engaged in engineering work in the Philippines, entering military service early in the war. He has been stationed at Camp Lee and Camp A. A. Humphreys, Virginia, at the Engineer Officers' Training Camp.

D. W. THROWER, assistant valuation engineer of the Illinois Central R.R., has been made valuation engineer, succeeding D. J. Brumley, who has entered the service of the corporation. Mr. Thrower has been in the service of the Illinois Central system since 1900, having been successively assistant engineer, road master, assistant engineer maintenance of way, district engineer of the Yazoo & Mississippi Valley at Memphis, and assistant valuation engineer.

MAJ. G. M. RICE, Corps of Engineers, who was previously chief engineer of the Puget Sound and Willapa Harbor Ry., has been promoted to the rank of lieutenant-colonel.

MAJOR JOHN R. FORDYCE of St. Louis has been appointed advisory engineer to the Federal barge lines of the Mississippi and Warrior rivers, in charge of construction of the terminals for the new river freight line between St. Louis and New Orleans. Previously Major Fordyce was in charge of cantonment construction at Camp Pike, Arkansas.

E. G. LANE, engineer maintenance of way of the western lines of the Baltimore & Ohio R.R., has been appointed chief engineer, succeeding L. G. Curtis, resigned. H. R. Gibson, district engineer maintenance of way at Cincinnati, succeeds Mr. Lane.

C. E. BRINSER, division engineer of the Pennsylvania R.R. at Philadelphia, has been appointed assistant superintendent of the New York division, with office at Trenton. Mr. Brinser, who was graduated from Franklin and Marshall College, and has been in the service of the Pennsylvania since 1900, has been division engineer at various points since 1910. He succeeds G. C. Koons, who is transferred to the Middle division, with headquarters at Mifflin, Penn.

FRANK M. PRESTON has been appointed city engineer of Victoria, B. C., succeeding C. H. Rust, who resigned to undertake corporation work as mentioned in *Engineering News-Record* of Aug. 22, p. 380. Mr. Preston has been assistant city engineer for the past five years.

U. A. G. DEY, assistant engineer of construction of the Canadian Pacific Ry. at Montreal, has been appointed assistant engineer of the Toronto terminals, succeeding G. H. Davis, who is promoted, as noted elsewhere.

PERLEY F. WALKER, dean of the School of Engineering, University of Kansas, has been promoted to the rank of colonel and given command of the 219th Regiment of Engineers now being organized at Camp A. A. Humphreys, Virginia.

R. MONTFORT, consulting engineer of the Louisville & Nashville R.R., has been appointed chief engineer for the corporation, with headquarters at Louisville.

A. W. NEWTON, chief engineer of the Chicago, Burlington & Quincy R.R., has been appointed chief engineer for the corporation.

ABRAHAM GIDEON, superintendent of the city water-supply and sewer system of Manila, P. I., has been appointed city engineer, succeeding Fred L. Patstone, who has entered the army.

R. C. WATKINS, division superintendent of the Texas lines of the Southern Pacific Co., at San Antonio, Tex., has been appointed maintenance of way engineer in Texas and Louisiana for the Southern Pacific corporation.

G. H. DAVIS, resident engineer of the Toronto terminals of the Canadian Pacific Ry., has been appointed assistant engineer maintenance of way, with office at Montreal.

HARRY G. CLARK, assistant to the vice-president of the Chicago, Rock Island & Pacific Ry., has been appointed chief engineer, succeeding C. A. Morse. Mr. Clark was born in 1875 at Leavenworth, Kan., and was graduated from the University of Kansas in 1898. The same year he entered railway service as chainman on the Atchison, Topeka & Santa Fé Ry. In 1900 he went to what is now the Choctaw district of the Rock Island system as resident engineer. From 1905 to

1909 he was district engineer of the Choctaw district. In the latter year he was made trainmaster, and in 1912, assistant to vice-president.

O. VON VOIGTLANDER, architect and engineer, Jackson, Mich., has closed his office for the duration of the war to enter the Engineer Officers' Reserve Corps with the rank of captain. He has been assigned to duty at Camp A. A. Humphreys, Virginia.

L. G. CURTIS, recently made chief engineer of the western lines of the Baltimore & Ohio R.R., has resigned to enter the service of the Baltimore & Ohio corporation.

F. W. VORMELKER has been appointed efficiency engineer for the Russel Motor Axle Co., North Detroit, Mich.

ROBERT S. BEARD, acting city engineer of St. Louis, has been ordered to report for duty in the Construction Division at Washington, D. C. It is expected that he will be commissioned with the rank of captain.

B. O. BENDIXON, engineer of Jefferson County, Washington, with headquarters at Port Townsend, has resigned.

F. E. MORROW, assistant chief engineer of the Chicago & Western Indiana R.R., and the Belt R.R. of Chicago, has been appointed chief engineer. Mr. Morrow was graduated from Purdue University in 1904. After a few months with the Illinois Steel Co. he entered the engineering department of the Chicago & North Western Ry. He remained with that company three years as rodman, instrumentman and assistant engineer successively, and was then appointed field engineer in the Division of Track and Roadway of the Board of Supervising Engineers, Chicago Traction. In 1910 he entered the Chicago & Western Indiana organization as office engineer. Three years later he was promoted to principal assistant engineer, and in 1915 to assistant chief engineer.

ROBERT H. FORD, engineer track elevation of the Chicago, Rock Island & Pacific Ry., has been appointed principal assistant engineer.

K. B. DUNCAN, valuation engineer of the Eastern lines of the Santa Fé system, has been appointed bridge engineer of the Gulf, Colorado & Santa Fé Ry. and other lines in Texas.

R. H. PINKHAM, assistant division superintendent of the Pennsylvania R.R. at Cresson, Penn., has been appointed superintendent of the New York, Philadelphia & Norfolk line of the Pennsylvania system. Mr. Pinkham, after graduating from the Massachusetts Institute of Technology in 1899, entered the service of the Pennsylvania in 1901 and was successively levelman, transitman, assistant supervisor, division engineer and assistant superintendent.

J. L. STARKIE, office engineer of the Gulf, Colorado & Santa Fé Ry. at Galveston, Tex., has been appointed assistant engineer for that road, the St. Louis, San Francisco & Texas and other lines under the same Federal manager.

WARREN H. BOOKER, for five years chief of the bureau of engineering and education of the North Carolina Board of Health, has been granted indefinite leave of absence to take up special work in France under the Commission for the Prevention of Tuberculosis in France.

ROBERT P. GARRETT, vice-president and treasurer of the Missouri Bridge & Iron Co., has been commissioned as captain in the Ordnance Department, and assigned to duty in Washington, D. C.

LEON C. GRAY, engineer in charge of field work for the public service department, Grand Rapids, Mich., has resigned to become associated with the Portland Cement Association, with headquarters at Detroit.

J. M. SILLIMAN, resident engineer of the Canadian Pacific Ry. at London, Ont., has been appointed division engineer of the Delaware & Hudson Co. at Oneonta, N. Y. He succeeds H. S. Rogers, resigned.

W. H. AMOS, deputy county engineer of Whitman County, Wash., with headquarters at Colfax, has resigned to enter the Corps of Engineers.

OBITUARY

JOHN HOWE PEYTON, president of the Nashville, Chattanooga & St. Louis Ry., died Sept. 14 at his home in Nashville, Tenn. Mr. Peyton left the post of assistant to the president and chief engineer of construction of the Louisville & Nashville R.R. late in 1913 to take the presidency of the Nashville, Chattanooga & St. Louis Ry. He was born Mar. 17, 1864, in Missouri, and studied at Roanoke College, West Virginia. He entered railroad service in 1881 as rodman on the Richmond & Louisville R.R. In 1889 he became assistant to the chief engineer of the Charleston, Clendennin & Sutton R.R. From 1892 to 1898 he was in private practice in general contracting. He served in the Army during the Spanish-American War. In 1900 he reëntered railroad service as resident engineer of the Chesapeake & Ohio Ry. Two years later he went to the Louisville & Nashville R.R. as locating engineer. The following year he was appointed construction engineer of the Atlanta, Knoxville & Northern Ry. From 1904 to 1909 he was again locating engineer of the Louisville & Nashville. In the latter year he was made consulting engineer of the North Coast R.R., but in the following year returned to the Louisville & Nashville as assistant to the president. The additional title of chief engineer of construction was given him in 1912, and he had charge of the extensive grade-revision and double-track program carried out by the Louisville & Nashville about that time, building lines that he had previously located. Mr. Peyton was a member of the American Society of Civil Engineers and of the American Railway Engineering Association.

CAPT. E. H. ANNEAR, Co. B, 43rd Regiment of Engineers, U. S. A., who recently arrived from France, died in Hoboken, N. J., Aug. 28. Captain Annear had studied as a cadet at West Point some years ago, but was compelled to resign on account of the ill health of his father. At the time of receiving his commission last January he was serving his third term as surveyor of Stanislaus County, California. He enceived two months' training at American University, Washington, D. C., and was sent abroad in April. Captain Annear had returned to the United States to act as military instructor.

WILLIAM WILLIAMS CREHORE, consulting engineer, of Westfield, N. J., and New York City, died Sept. 12 in Los Angeles, Calif. Mr. Crehore was born in Cleveland in 1864 and was graduated from Yale University with the degree of A.B. in 1886, and, from the Sheffield Scientific School with the degree of Ph. B. in 1888. A year later he became inspector of erection in the bridge department of the Pennsylvania R.R., and shortly afterward entered the service of the Baltimore & Ohio R.R. as a draftsman. During 1891 and 1892 he was chief draftsman for the Wallis Iron Works at Jersey City, N. J., and entered private practice in 1892 as a consulting engineer in construction work with headquarters in New York City. He became a member of the firm of the Structural Engineering Co. in 1896, and was in charge of design and supervision of fire-resistive buildings, factories, power plants and other structures. Mr. Crehore's work also included specialization in reports on the safety of bridges, power stations, factory buildings and storage houses, and testimony in court on questions of construction, and interpretations of contracts. He was the author of "Tables and Diagrams for Use of Engineers and Architects" and other architectural books. He was a member of the American Society of Civil Engineers and the Authors' League of America.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Building Industries Active at Washington

Holding of Future Construction to Very Close Limits Evident in Conferences with War Industries Board

BY WILLIAM B. KING

of King & King, Attorneys and Counsellors at Law, and Washington Representative, National Federation of Building Industries

Reference was made in *Engineering News-Record* of Aug. 29, p. 429, to the District of Columbia labor regulations apparently effecting a stoppage of construction in the district. It is gratifying to know that the organization of the National Federation of Building Industries established at the convention held under the auspices of the Chamber of Commerce of the United States at Atlantic City, July 16, has vigorously undertaken the work thus advocated. It has had a formal hearing before Chairman Baruch and informal conferences with other officials of the War Industries Board.

The policy of the board, impelled by the necessities of the war for labor, material, fuel and capital, continues extremely restrictive of construction enterprise, and makes it evident that, if construction, except for the United States, is not to be practically stopped, it will only be because the board may be convinced that certain private construction, such as farm improvements, is necessary to the war, or that some labor and material are available in certain localities, which would be idle and unused if construction were not locally permitted. The very difficulty of present conditions is the strongest reason why the construction interests should unite in keeping a central organization on watch to see that the restrictive policy is not carried so far as to defeat itself and result in local idleness and widespread business disaster.

ALL CONSTRUCTION PROJECTS TO BE LICENSED

The War Industries Board has just issued orders requiring licenses to be obtained for all construction projects, whether building, roads or of other character, except five specified classes, as noted on page 516 of this journal for Sept. 12.

The representatives of the War Industries Board have informed the National Federation that they would be glad to receive any suggestions from them for the proper administration of this new responsibility. The board recognizes the very great responsibility involved in the stringent restrictions promulgated, and great regret has been expressed that it should seem necessary to issue them. It should be understood that the board has no desire to hinder construction except as this policy is held to be required by war needs. It will be the purpose of the National Federation of Building Industries to gather all the information possible in regard to the best method of securing in the granting of licenses, fairness, equality and just consideration of the construction needs of the country.

Conditions necessarily vary in different localities. Local needs and local opportunities for labor and material will greatly differ. Considerable farm construction for the care of crops seems absolutely necessary. Sanitary needs can not be neglected. Community changes require housing, even in localities where direct war construction is not going on. Destruction of buildings by fire demands reconstruction. Factories must be built for the imperative needs of the civil population. The central representatives of the construction interests need to take all these conditions into consideration and to help the War Industries Board to avoid the evils that will surely come, if restriction be carried too far.

Danger is to be apprehended that the unguided grant of discretion for licensing to many local aids of the State Councils of Defense will lead to widely different standards of license or refusal. Instructions by the War Industries Board would seem essential.

It has been definitely promised that the views of the National Federation will be carefully considered and that a full hearing will be given to its representatives upon any point involved in the administration of the regulations restricting building.

Army Educational Service Asks Catalogues for Soldiers

A need for catalogues and supplementary literature for work among returned soldiers is announced by Maj. Fred T. Reagle, Sanitary Corps, U. S. A. He asks that manufacturers send pamphlets describing their lines which may touch upon the various phases of the work of the educational service, used in the courses given to disabled soldier patients. The courses are those given in any polytechnical school, covering forty or more subjects. Major Reagle states that the need is urgent, and requests as early action as possible.

Supplying Army Centered in General Staff

Purchasing, Storage and Traffic Under One Director—Corps Makes Up Own Requirements

(Washington Correspondence)

Reorganization of the Army supply system, whereby the entire process of purchasing, storage and transportation is concentrated in a branch of the General Staff, continues to progress. As stated in *Engineering News-Record* of Aug. 1, p. 246, the purchasing of the many different commodities required by the Army was shifted early this summer so that each branch of the War Department purchases all of the material about which it has special expert knowledge, regardless of whether it will use this particular material or not. Thus, the Ordnance Department, being expert on machine tools, was delegated to purchase all the machine tools for the Army, even such tools as were required by the Corps of Engineers in some of its overseas shops or by the Aviation Corps for repair work. This allocation of materials to specific corps has continued beyond the stage in which it was when reported six weeks ago in these columns, and now embraces all the commodities noted in the accompanying table. In this table the various products bought by the Army are given alphabetically, together with the bureau which purchases the product.

MORE POWER FOR THE DIVISION

Under date of Aug. 27 the purchase, storage and traffic division of the General Staff received more power in regard to supplying the Army. Under this new order this office, which is directed by Maj. Gen. G. W. Goethals, assistant chief of staff, has "the responsibility for and authority over the supply of the Army, including analysis and computation of requirements, purchase, production, inspection, acceptance, transportation, storage, issue within the United States and embarkation," and further is "in charge of the relations with all other agencies, Governmental and otherwise, in regard to Army supply, including representation of the War Department on the War Industries Board in business with the representatives of the allied governments." A radical feature of the order is the statement that the chiefs of all other bureaus, corps and departments of the Army shall report to the Director of Purchase, Storage and Traffic on all matters enumerated in the preceding quotations.

Under this order it is probable that

as soon as the details can be arranged the various purchasing departments of the various corps will be taken over intact by the General Staff. In many cases this means that the officers of these corps will be recommissioned in the General Staff—that is, for instance, the Engineer Depot will become a branch of the Division of Purchase, Storage and Traffic of the General Staff and entrusted with the purchase of all supplies of which the engineers have expert knowledge. Such a move, of course, is in line with the procedure in large commercial establishments where the provisions for purchasing are centralized.

Divisions of the Supply Corps

Under the scheme which is being worked out the supplies for the Army will be passed through a routine of six separate heads: namely, requirements, engineering, purchase, production, storage and embarkation. The requirements section will be centralized in each of the respective corps. Each corps, knowing its own necessities, will establish its requirements on the basis of the size of the Army laid down by the General Staff, and will report these requirements through a centralized requirements bureau in the Division of Purchase, Storage and Traffic. The same applies to engineering, which will be taken care of in each of the separate corps. Purchase and production form a separate branch, consolidated, as stated in the preceding paragraph, in the General Staff, except for such highly technical details as require the special attention of the separate corps.

Storage becomes a General Staff matter. Quartermasters' signal, engineers'—all stores in fact—pass out of the hands of the respective corps when once purchased and into general storehouses, where they are held at the disposition of the Division of Purchase, Storage and Traffic to be turned over, when wanted overseas, to the embarkation service, which is under the same direction.

Organization Committee of Zinc Institute Holds Meeting

The organization committee of the American Zinc Institute meets in Chicago Sept. 20. The seven members will select 14 others to form the board of direction of the institute for the coming year. The aim of the institute, as outlined at the St. Louis convention in July, is to stabilize the zinc industry. It is the opinion of the officers and members that a better understanding between miner, smelter and consumer is desirable and possible, and to accomplish this the following tentative program will be followed: (1) To educate the public in new uses of zinc; (2) to establish a statistical bureau; (3) to increase the exportation of zinc, and (4) to improve organization and management throughout the industry.

The action of the organization will be subject to ratification by letter ballot, and it is believed that Washington prefers to deal with the industries through such organizations.

DISTRIBUTION OF MATERIALS TO BE PURCHASED BY WAR DEPARTMENT

Articles	Procuring Bureau
Aeroplane cloths	Aircraft
Alloys, chrome	Ordnance
Alloys, ferro	Ordnance
Alloys, manganese	Ordnance
Aluminum	Ordnance
Ammonium, nitrate	Ordnance
Antimony	Ordnance
Balloon cloths	Aircraft
Barbed wire	Engineers
Barometers	Ordnance
Bars, reinforcing	Construction
Batteries, dry	Ordnance
Blast furnace and steel mill products	Ordnance
Bleaching powders	Chemical warfare
Belts (for engineers)	Engineers
Brass tubing	Aircraft
Building materials	Construction
Bunks	Quartermaster
Burlap	Quartermaster
Cable, electric	Aircraft
Cartons	Quartermaster
Cement	Construction
Chain	Engineers
Chain, artillery	Ordnance
Chain, automobile drive	Quartermaster
Chain, non-skid	Quartermaster
Chemicals	Ordnance
Chemicals, medical	Medical
Chemicals, organic	Quartermaster
Chemicals, special	Aircraft products
Chemicals, toxic	Chemical warfare
Chests, tool	Quartermaster
Chlorine (liquid)	Chemical warfare
Chrome alloys	Ordnance
Clay products	Construction
Clocks, etc	Aircraft
Cloth, cartridge	Ordnance
Cloth, cotton	Quartermaster
Clothing, aviators	Aircraft
Coal gas products	Ordnance
Coal tar products	Ordnance
Compasses	Aircraft
Containers, paint, etc	Engineers
Containers, gas	Chemical warfare
Copper tubing	Aircraft
Cots	Quartermaster
Cotton goods	Quartermaster
Cotton linters	Ordnance
Cotton rope	Quartermaster
Cranes, gantry	Engineers
Cranes, locomotive	Engineers
Distillates, wood	Aircraft
Dressings, surgical	Medical
Driers, paint, etc	Engineers
Dyestuffs, organic	Quartermaster
Elastic tape	Chemical warfare
Electric cable	Aircraft
Electrical equipment and supplies	Construction
Electric, gas generator sets	Engineers
Electric wire	Signal
Electric wire, heavy power	Construction
Enamels (all ingredients)	Engineers
Engines, fire	Construction
Engines, fire, motor drawn	Motor transport
Engines, gas	Engineers
Engines, gas, airplane	Aircraft
Engines, steam	(See boilers)
Equipment, electrical	Construction
Equipment, forging	Ordnance
Equipment, refrigerating	Construction
Extinguishers, hand, fire	Quartermaster
Fabric, silk	Quartermaster
Fencing	Construction
Fiber hull	Ordnance
Fire apparatus	Construction
Fire apparatus (automotive	Motor transport
Fire extinguishers (hand)	Quartermaster
Fire hose	Engineers
Flashlights, dry cell	Ordnance
Forging Equipment	Ordnance
Gantry cranes	Engineers
Garment workers' power tools and machinery	Quartermaster
Gases, acetylene, hydrogen, oxygen	Chemical warfare
Gas, coal products	Ordnance
Gas, containers	Chemical warfare
Gas electric generator sets	Engineers
Gages, oil, air, gasoline	Aircraft
Generator sets, gas-electric	Engineers
Glass, laminated	Chemical warfare
Glass, optical	Ordnance
Goods, cotton	Quartermaster
Goods, rubber	Quartermaster
Goods, rubber mechanical	Engineers
Goods, woolen	Quartermaster
Gravel	Construction
Gray goods	Medical
Hangars, steel	Aircraft
Hardware, builders	Construction
Hardware, general	Quartermaster
Hardware, rough	Construction
Heaters, room	Construction
Heating equipment and supplies	Construction
Horse masks	Gas defense
Hose, fire	Engineers
Ice boxes	Quartermaster
Instruments, optical	Ordnance
Instruments, surveying and topographical	Engineers
Japans (all ingredients)	Engineers
Jute	Quartermaster
Lacquers (all ingredients)	Engineers
Lanterns, portable cap	Ordnance
Lanterns, portable hand	Ordnance
Leather	Quartermaster
Leather goods	Quartermaster
Linen	Quartermaster
Linen fabric, balloons and airplanes	Aircraft
Linen thread	Quartermaster
Linseed oil	Engineers
Linters, cotton	Ordnance
Locomotive cranes	Engineers
Lumber	Construction
Lumber, airplane	Aircraft
Machine tools	Ordnance
Machinery, refrigerating	Construction
Machinery, structural and iron workers	Engineers
Machinery, wood working	Engineers
Manganese alloys	Ordnance
Manila rope	Quartermaster
Materials, building	Construction
Metals, non-ferrous	Ordnance
Mica	Aircraft
Mill products, steel	Ordnance
Mineral spirits	Engineers
Needles	Quartermaster
Needles, surgical	Medical
Nitrates	Ordnance
Optical glass	Ordnance
Optical instruments	Ordnance
Paint, all	Engineers
Paper	Quartermaster
Phosphorus	Chemical warfare
Pig tin	Ordnance
Plate tin	Ordnance
Platinum	Ordnance
Plumbing equipment and supplies	Construction
Pontoon wagons	Engineers
Posts, steel fence	Engineers
Poultry wire	Engineers
Powders, bleaching	Quartermaster
Powders, washing	Quartermaster
Products, blast furnace	Ordnance
Products, coal gas	Ordnance
Products, steel mill	Ordnance
Pumps, gasoline	Quartermaster
Pumps, oil	Quartermaster
Pumps, general	Engineers
Pumps, tank car	Engineers
Pumps, water supply	Construction
Radio equipment	Signal
Railway contractor plant	Engineers
Railway equipment	Engineers
Recorders, time interval	Ordnance
Refrigerating equipment	Construction
Refrigerating machinery	Construction
Refrigerators	Quartermaster
Reinforcing bars	Construction
Rope, cotton	Quartermaster
Rope, manila	Quartermaster
Rope, sisal	Quartermaster
Roofing materials	Construction
Rubber	Quartermaster
Rubber goods	Quartermaster
Rubber goods, mechanical	Engineers
Sand	Construction
Searchlights, arc	Ordnance
Shovels, steam	Engineers
Silk, fabric	Quartermaster
Silk, thread	Quartermaster
Silk, yarn	Quartermaster
Sisal rope	Quartermaster
Soaps	Quartermaster
Soaps (surgical)	Medical
Sodium nitrate	Ordnance
Spirits, mineral	Engineers
Sprinkler system	Construction
Staples, barbed wire	Engineers
Steel mill products	Ordnance
Steel fence posts	Engineers
Steel hangars	Aircraft
Steel, structural	Construction
Structural steel	Construction
Supplies, electrical equipment	Construction
Surgical needles	Medical
Tanks, water-supply	Construction
Tanks, gasoline	Quartermaster
Tanks, oil	Quartermaster
Tar, coal products	Ordnance
Telephone equipment	Signal
Telegraph equipment	Signal
Thermometers	Aircraft
Thermometers, medical	Medical
Thread, silk	Quartermaster
Time-interval recorders	Ordnance
Tool chests	Quartermaster
Tools, hand	Quartermaster
Tools, machine	Ordnance
Tools, power, garment workers and saddlers	Quartermaster
Tools, power, iron and structural workers	Engineers
Tools, power, woodworking	Engineers
Tubing, brass	Aircraft
Tubing, copper	Aircraft
Tungsten	Ordnance
Turpentine	Engineers
Turpentine, medicinal	Medical
Varnishes (all ingredients)	Engineers
Varnish, spar	Aircraft
Vehicles, animal or handdrawn, wood	Quartermaster
Ventilating equipment	Construction
Wagons, all	Quartermaster
Watches, stop	Ordnance
Washing powders	Quartermaster
Water-supply equipment	Construction
Water-supply fixtures	Construction
Wire, barbed	Engineers
Wire, carts, steel	Ordnance
Wire, electric	Aircraft
Wire, fencing, woven	Quartermaster
Wire, netting, poultry	Engineers
Wire, products, except as noted	Quartermaster
Wood distillates	Aircraft
Woolen goods	Quartermaster
Zinc	Quartermaster